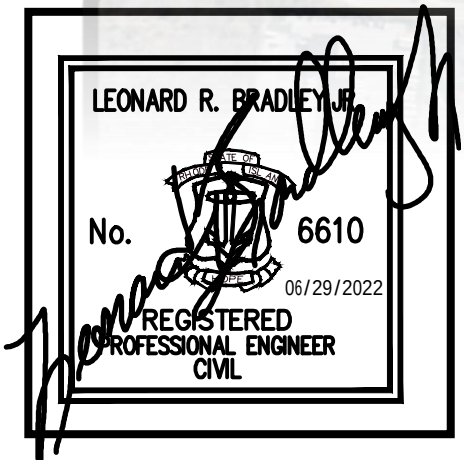
DiPrete Engineering

Stormwater Management Report



Seasons Corner Market

Located in Cranston, RI

Applicant: Colbea Enterprises, LLC

06-29-22

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Executive Summary

On behalf of the Client, we are submitting drainage calculations for the proposed redevelopment on Assessor's Plat 36 Lots 116 and 117, located at 2050 Plainfield Pike in Cranston, RI. The applicant is proposing to remove the existing building and surrounding improvements to construct a new 5,000 SF convenience store building with a rear drive-through, canopy with 5 dispenser islands, two new 15,000-gallon USTs; new parking and circulation layout and associated stormwater and water quality improvements. The post development stormwater will be treated for water quality using Best Management Practices (BMPs).

Under the RISDISM, the majority the site is considered a redevelopment site since the existing site is over 40% impervious. Overall, the site proposes to reduce impervious area and provide water quality for at least 50% of the proposed impervious area. A portion of the site was developed in a parking expansion in 2013, which will be treated for 100% water quality treatment. The site meets the RISDISM through various BMPs.

To mitigate post development flows on site, a drainage network and slot drains are utilized to convey runoff to an oil-water separator for pretreatment and FocalPoint High Performance Modular Biofiltration System (HPBMS) with an ACF R-Tank underdrain and impermeable liner is used to treat the water quality storm and then conveyed to the existing drainage system. A portion of the site is also captured with a slot drain and conveyed to an existing bioretention area to treat the water quality storm then conveyed to the existing drainage system. The existing bioretention area was constructed in 2013 under a previous RIDEM Permit Approval #OCTA 12-029.

This report details how the site has an overall net decrease in stormwater runoff from pre development to post development conditions, and how the proposed BMPs will provide water quality treatment for stormwater runoff. There is no requirement to match pre to post development flows in the water quality storm, it is only included to evaluate the effectiveness of the BMPs to treat the first flush of runoff.

Design Point 1 represents the stormwater discharge to the southeast, an unnamed tributary to the Meshanticut Brook. Design Point 2 is an existing RIDOT catch basin the DOT ROW on Plainfield Pike. Design Point 3 is the existing RIDOT drainage network at the DOT ROW Intersection of Plainfield Pike and Sailor Way. Design Point 1 discharges to the Pawtuxet River Watershed and Design Points 2 and 3 discharge to the Pocassett River Watershed.

Pre Development vs. Post Development Mitigated Peak Flow

The tables below present a summary of the predevelopment flows vs. the mitigated post development flows.

Southeast Discharge: (DP-1)

Conditions – Peak Flow	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.54	1.48	1.88	3.35	5.48	8.62
Post Dev	0.56	2.24	2.89	4.69	6.73	10.06
Net Change	**0.02**	**0.76**	**1.01**	**1.34**	**1.25**	**1.44**

All flows in cubic feet per second (cfs)

Plainfield Pike CB: (DP-2)

Conditions – Peak Flow	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.29	0.84	1.10	1.77	2.27	3.34
Post Dev	0.14	0.40	0.55	0.93	1.22	1.84
Net Change	**-0.15**	**-0.44**	**-0.55**	**-0.84**	**-1.05**	**-1.50**

All flows in cubic feet per second (cfs)

Plainfield Pike/Sailor Way Intersection CBs: (DP-3)

Conditions – Peak Flow	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.36	1.13	1.55	2.73	3.63	5.60
Post Dev	0.19	0.73	1.09	2.15	2.99	4.88
Net Change	**-0.17**	**-0.40**	**-0.46**	**-0.58**	**-0.64**	**-0.72**

All flows in cubic feet per second (cfs)

Totals:

Conditions – Peak Flow	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	1.19	3.45	4.53	7.85	11.38	17.56
Post Dev	0.89	3.37	4.53	7.77	10.94	16.78
Net Change	**-0.30**	**-0.08**	**0.00**	**-0.08**	**-0.44**	**-0.78**

Pre Development vs. Post Development Mitigated Volume to DOT ROW

The tables below present a summary of the predevelopment volumes vs. the mitigated post development volumes for the Design Points affecting the DOT ROW. The tables show a decrease in stormwater runoff volume for all storms included in the analysis.

Plainfield Pike CB: (DP-2)

Conditions – Volume	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.023	0.061	0.079	0.131	0.171	0.257
Post Dev	0.011	0.029	0.039	0.067	0.089	0.138
Net Change	**-0.012**	**-0.032**	**-0.040**	**-0.064**	**-0.082**	**-0.119**

All volumes in acre-feet (ac-ft)

Plainfield Pike/Sailor Way Intersection CBs: (DP-3)

Conditions – Volume	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.036	0.082	0.112	0.198	0.266	0.417
Post Dev	0.016	0.056	0.081	0.155	0.216	0.355
Net Change	**-0.020**	**-0.026**	**-0.031**	**-0.043**	**-0.050**	**-0.062**

All volumes in acre-feet (ac-ft)

APPENDIX A: STORMWATER MANAGEMENT PLAN CHECKLIST AND LID PLANNING REPORT – STORMWATER DESIGN SUMMARY

PROJECT NAME **Seasons Corner Market – Cranston**	**(RIDEM USE ONLY)** **STW/WQC File #:** **Date Received:**
TOWN **Cranston**	
BRIEF PROJECT DESCRIPTION: Redevelopment of lot including demolition of existing building and construction of a 5,000 SF Seasons Corner Market/Gas station with parking, utilities and associated drainage infrastructure.	

Stormwater Management Plan (SMP) Elements – Minimum Standards

When submitting a SMP,[1] submit four separately bound documents: Appendix A Checklist; Stormwater Site Planning, Analysis and Design Report with Plan Set/Drawings; Soil Erosion and Sediment Control (SESC) Plan, and Post Construction Operations and Maintenance (O&M) Plan. Please refer to Suggestions to Promote Brevity.

Note: **All stormwater construction projects must create a Stormwater Management Plan (SMP). However, not every element listed below is required per the RIDEM Stormwater Rules and the RIPDES Construction General Permit (CGP). This checklist will help identify the required elements to be submitted with an Application for Stormwater Construction Permit & Water Quality Certification.**

PART 1. PROJECT AND SITE INFORMATION

PROJECT TYPE (Check all that apply)

☐ Residential	☒ Commercial	☐ Federal	☐ Retrofit	☐ Restoration
☐ Road	☐ Utility	☐ Fill	☐ Dredge	☐ Mine
☐ Other (specify):				

SITE INFORMATION

☒ Vicinity Map

INITIAL DISCHARGE LOCATION(S): The WQv discharges to: (You may choose more than one answer if several discharge points are associated with the project.)

☐ **Groundwater**	☒ **Surface Water**	☒ **MS4**
☐ GAA	☒ Isolated Wetland	☒ RIDOT
☐ GA	☐ Named Waterbody	☐ RIDOT Alteration Permit is Approved
☐ GB	☐ Unnamed Waterbody Connected to Named Waterbody	☒ Town
		☐ Other (specify):

ULTIMATE RECEIVING WATERBODY LOCATION(S): Include pertinent information that applies to both WQ_v and flow from larger storm events including overflows. Choose all that apply, and repeat table for each waterbody.

☒ Groundwater or Disconnected Wetland	☐ SRWP		
☒ Waterbody Name: Unnamed Tributary to Meshanticut Brook	☐ Coldwater	☒ Warmwater	☐ Unassessed
☒ Waterbody ID: RI0006017R-02	☐ 4th order stream of pond 50 acres or more		
☒ TMDL for: Enterococcus	☐ Watershed of flood prone river (e.g., Pocasset River)		
☐ Contributes to a priority outfall listed in the TMDL	☐ Contributes stormwater to a public beach		

[1] Applications for a Construction General Permit that do not require any other permits from RIDEM and will disturb less than 5 acres over the entire course of the project do not need to submit a SMP. The Appendix A checklist must still be submitted.

PROJECT HISTORY		
☒ RIDEM Pre- Application Meeting	Meeting Date: May 12, 2022	☒ Minutes Attached
☐ Municipal Master Plan Approval	Approval Date:	☐ Minutes Attached
☐ Subdivision Suitability Required	Approval #:	
☐ Previous Enforcement Action has been taken on the property	Enforcement #:	

FLOODPLAIN & FLOODWAY See Guidance Pertaining to Floodplain and Floodways	
☐ Riverine 100-year floodplain: **FEMA FLOODPLAIN FIRMETTE** has been reviewed and the 100-year floodplain is on site	
☐ Delineated from FEMA Maps	
NOTE: Per Rule 250-RICR-150-10-8-1.1(B)(5)(d)(3), provide volumetric floodplain compensation calculations for cut and fill/displacement calculated by qualified professional	
☐ Calculated by Professional Engineer	
☐ Calculations are provided for cut vs. fill/displacement volumes proposed within the 100-year floodplain	Amount of Fill (CY):
	Amount of Cut (CY):
☐ Restrictions or modifications are proposed to the flow path or velocities in a floodway	
☐ Floodplain storage capacity is impacted	
☒ Project area is not within 100-year floodplain as defined by RIDEM	

CRMC JURISDICTION
☐ CRMC Assent required
☐ Property subject to a Special Area Management Plan (SAMP). If so, specify which SAMP:
☐ Sea level rise mitigation has been designed into this project

LUHPPL IDENTIFICATION - MINIMUM STANDARD 8:			
1. OFFICE OF Land Revitalization and Sustainable Materials Management (OLRSMM)			
	☐ Known or suspected releases of HAZARDOUS MATERIAL are present at the site (Hazardous Material is defined in Rule 1.4(A)(33) of 250-140-30-1 of the RIDEM Rules and Regulations for Investigation and Remediation of Hazardous Materials (the Remediation Regulations))		**RIDEM CONTACT:**
	☐ Known or suspected releases of PETROLEUM PRODUCT are present at the site (Petroleum Product as defined in Rule 1.5(A)(84) of 250-140-25-1 of the RIDEM Rules and Regulations for Underground Storage Facilities Used for Regulated Substances and Hazardous Materials)		
	☒ This site is identified on the RIDEM Environmental Resources Map as one of the following regulated facilities		**SITE ID#**:
		☐ CERCLIS/Superfund (NPL)	
		☐ State Hazardous Waste Site (SHWS)	
		☐ Environmental Land Usage Restriction (ELUR)	
		☒ Leaking Underground Storage Tank (LUST)	7122-LS, UST-3615
		☐ Closed Landfill	
Note: If any boxes in 1 above are checked, the applicant must contact the RIDEM OLRSMM Project Manager associated with the Site to determine if subsurface infiltration of stormwater is allowable for the project. Indicate if the infiltration corresponds to "Red," "Yellow" or "Green" as described in Section 3.2.8 of the RISDISM Guidance (Subsurface Contamination Guidance). Also, note and reference approval in PART 3, Minimum Standard 2: Groundwater Recharge/Infiltration**.**			
2. PER MINIMUM STANDARD 8 of RICR 8.14.C.1-6 "LUHPPLS," THE SITE IS/HAS:			
	☐ Industrial Site with RIPDES MSGP, except where No Exposure Certification exists. http://www.dem.ri.gov/programs/water/permits/ripdes/stormwater/status.php		
	☒ Auto Fueling Facility (e.g., gas station)		
	☐ Exterior Vehicles Service, Maintenance, or Equipment Cleaning Area		

	☐ Road Salt Storage and Loading Areas (exposed to rainwater)	
	☐ Outdoor Storage and Loading/Unloading of Hazardous Substances	
3.	**STORMWATER INDUSTRIAL PERMITTING**	
	☒ The site is associated with existing or proposed activities that are considered Land Uses with Higher Potential Pollutant Loads (LUHPPLS) (see RICR 8.14.C)	Activities: Sector:
	☐ Construction is proposed on a site that is subject to THE MULTI-SECTOR GENERAL PERMIT (MSGP) UNDER RULE 31(B)15 OF THE RIPDES REGULATIONS.	MSGP permit #
	☐ Additional stormwater treatment is required by the MSGP Explain:	

REDEVELOPMENT STANDARD – MINIMUM STANDARD 6		
☒ Pre Construction Impervious Area		
	☒ Total Pre-Construction Impervious Area (**TIA**) =1.411 Ac	
	☒ Total Site Area (**TSA**) = 2.227 Ac	
	☐ Jurisdictional Wetlands (**JW**)	
	☐ Conservation Land (**CL**)	
☒ Calculate the Site Size (defined as contiguous properties under same ownership)		
	☒ Site Size (**SS**) = (**TSA**) – (**JW**) – (**CL**) = 2.227 Ac	
	☐ (**TIA**) / (**SS**) = 0.63	☒ (**TIA**) / (**SS**) >**0.4**? Yes
☒ YES, Redevelopment		

PART 2. LOW IMPACT DEVELOPMENT ASSESSMENT – MINIMUM STANDARD 1

(NOT REQUIRED FOR REDEVELOPMENT OR RETROFITS)

This section may be deleted if not required.

Note: A written description must be provided specifying why each method is not being used or is not applicable at the Site. Appropriate answers may include:

- Town requires … (state the specific local requirement)
- Meets Town's dimensional requirement of …
- Not practical for site because …
- Applying for waiver/variance to achieve this (pending/approved/denied)
- Applying for wavier/variance to seek relief from this (pending/approved/denied)

A) PRESERVATION OF UNDISTURBED AREAS, BUFFERS, AND FLOODPLAINS	**IF NOT IMPLEMENTED, EXPLAIN HERE**
☒ Sensitive resource areas and site constraints are identified (required) ☒ Local development regulations have been reviewed (required) ☐ All vegetated buffers and coastal and freshwater wetlands will be protected during and after construction ☐ Conservation Development or another site design technique has been incorporated to protect open space and pre-development hydrology. **Note:** If Conservation Development has been used, check box and skip to Subpart C ☒ As much natural vegetation and pre-development hydrology as possible has been maintained	

B) LOCATE DEVELOPMENT IN LESS SENSITIVE AREAS AND WORK WITH THE NATURAL LANDSCAPE CONDITIONS, HYDROLOGY, AND SOILS ☒ Development sites and building envelopes have been appropriately distanced from wetlands and waterbodies ☐ Development and stormwater systems have been located in areas with greatest infiltration capacity (e.g., soil groups A and B) ☐ Plans show measures to prevent soil compaction in areas designated as Qualified Pervious Areas (QPA's) ☒ Development sites and building envelopes have been positioned outside of floodplains ☒ Site design positions buildings, roadways and parking areas in a manner that avoids impacts to surface water features ☒ Development sites and building envelopes have been located to minimize impacts to steep slopes (≥15%) ☐ Other (describe):	
C) MINIMIZE CLEARING AND GRADING ☒ Site clearing has been restricted to <u>minimum area needed</u> for building footprints, development activities, construction access, and safety. ☒ Site has been designed to position buildings, roadways, and parking areas in a manner that minimizes grading (cut and fill quantities) ☐ Protection for stands of trees and individual trees and their root zones to be preserved has been specified, and such protection extends at least to the tree canopy drip line(s) ☐ Plan notes specify that public trees removed or damaged during construction shall be replaced with equivalent	
D) REDUCE IMPERVIOUS COVER ☐ Reduced roadway widths (≤22 feet for ADT ≤ 400; ≤ 26 feet for ADT 400 - 2,000) ☐ Reduced driveway areas (length minimized via reduced ROW width (≤ 45 ft.) and/or reduced (or absolute minimum) front yard setback; width minimized to ≤ 9 ft. wide one lane; ≤ 18 ft. wide two lanes; shared driveways; pervious surface) ☐ Reduced building footprint: Explain approach: ☐ Reduced sidewalk area (≤ 4 ft. wide; one side of the street; unpaved path; pervious surface) ☐ Reduced cul-de-sacs (radius < 45 ft; vegetated island; alternative turn-around) ☐ Reduced parking lot area: Explain approach ☐ Use of pervious surfaces for driveways, sidewalks, parking areas/overflow parking areas, etc. ☒ Minimized impervious surfaces (project meets or is less than maximum specified by Zoning Ordinance) ☐ Other (describe):	
E) DISCONNECT IMPERVIOUS AREA ☐ Impervious surfaces have been disconnected, and runoff has been diverted to QPAs to the maximum extent possible ☐ Residential street edges allow side-of-the-road drainage into vegetated open swales ☐ Parking lot landscaping breaks up impervious expanse AND accepts runoff ☐ Other (describe):	
F) MITIGATE RUNOFF AT THE POINT OF GENERATION ☒ Small-scale BMPs have been designated to treat runoff as close as possible to the source	

G) PROVIDE LOW-MAINTENANCE NATIVE VEGETATION ☒ Low-maintenance landscaping has been proposed using native species and cultivars ☒ Plantings of native trees and shrubs in areas previously cleared of native vegetation are shown on site plan ☒ Lawn areas have been limited/minimized, and yards have been kept undisturbed to the maximum extent practicable on residential lots	
H) RESTORE STREAMS/WETLANDS ☐ Historic drainage patterns have been restored by removing closed drainage systems, daylighting buried streams, and/or restoring degraded stream channels and/or wetlands ☐ Removal of invasive species ☐ Other	

PART 3. SUMMARY OF REMAINING STANDARDS

GROUNDWATER RECHARGE – MINIMUM STANDARD 2		
YES	**NO**	
☐	☒	The project has been designed to meet the groundwater recharge standard.
☒	☐	If "No," the justification for groundwater recharge criterion waiver has been explained in the Narrative (e.g., threat of groundwater contamination or physical limitation), if applicable (see RICR 8.8.D);
☒	☐	Your waiver request has been explained in the Narrative, if applicable.
☒	☐	Is this site identified as a Regulated Facility in Part 1, Minimum Standard 8: LUHPPL Identification?
☐	☒	If "Yes," has approval for infiltration by the OLRSMM Site Project Manager, per Part 1, Minimum Standard 8, been requested?

TABLE 2-1: Summary of Recharge (see RISDISM Section 3.3.2) N/A
(Add or Subtract Rows as Necessary)

Design Point	**Impervious Area Treated (sq ft)**	**Total Re_v Required (cu ft)**	**LID Stormwater Credits (see RISDISM Section 4.6.1)** **Portion of Re_v directed to a QPA (cu ft)**	**Recharge Required by Remaining BMPs (cu ft)**	**Recharge Provided by BMPs (cu ft)**
DP-1:					

Notes:
1. Only BMPs listed in RISDISM Table 3-5 "List of BMPs Acceptable for Recharge" may be used to meet the recharge requirement.
2. Recharge requirement must be satisfied for each waterbody ID.

☒ Indicate where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.):

Stormwater Management Report Section 3.2

WATER QUALITY – MINIMUM STANDARD 3		
YES	**NO**	
☒	☐	Does this project meet or exceed the required water quality volume WQv (see RICR 8.9.E-I)?
☒	☐	Is the proposed final impervious cover greater than 20% of the disturbed area (see RICR 8.9.E-I)?
☒	☐	If "Yes," either the Modified Curve Number Method or the Split Pervious/Impervious method in Hydro-CAD was used to calculate WQv; or,
☐	☐	If "Yes," either TR-55 or TR-20 was used to calculate WQv; and,
☐	☐	If "No," the project meets the minimum WQv of 0.2 watershed inches over the entire disturbed area.
☐	☐	Not Applicable
☒	☐	Does this project meet or exceed the ability to treat required water quality flow WQf (see RICR 8.9.I.1-3)?
☐	☒	Does this project propose an increase of impervious cover to a receiving water body with impairments? If "Yes," please indicate below the method that was used to address the water quality requirements of no further degradation to a low-quality water.
☐	☒	RICR 8.36. A Pollutant Loading Analysis is needed and has been completed.
☒	☐	The Water Quality Guidance Document (Water Quality Goals and Pollutant Loading Analysis Guidance for Discharges to Impaired Waters) has been followed as applicable.
☒	☐	BMPs are proposed that are on the approved technology list . If "Yes," please provide all required worksheets from the manufacturer.
☐	☒	Additional pollutant-specific requirements and/or pollutant removal efficiencies are applicable to the site as the result of a TMDL, SAMP, or other watershed-specific requirements. If "Yes," please describe:

TABLE 3-1: Summary of Water Quality (see RICR 8.9)

Design Point and WB ID	Impervious area treated (sq ft)	Total WQ_v Required (cu ft)	LID Stormwater Credits (see RICR 8.18) WQv directed to a QPA (cu ft)	Water Quality Treatment Remaining (cu ft)	Water Quality Provided by BMPs (cu ft)
DP-1:	27,312	1,822	0	1,822	208
TOTALS:					

Notes:
1. Only BMPs listed in RICR 8.20 and 8.25 or the Approved Technologies List of BMPs is Acceptable for Water Quality treatment.
2. For each Design Point, the Water Quality Volume Standard must be met for each Waterbody ID.

☒ YES ☐ NO	This project has met the setback requirements for each BMP. If "No," please explain:

☒ Indicate where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.):
Stormwater Management Report Section 3.3

CONVEYANCE AND NATURAL CHANNEL PROTECTION (RICR 8.10) – MINIMUM STANDARD 4 N/A			
YES	**NO**		
☒	☐	Is this standard waived? If "Yes," please indicate one or more of the reasons below:	
		☐	The project directs discharge to a large river (i.e., 4th-order stream or larger. See RISDISM Appendix I for State-wide list and map of stream orders), bodies of water >50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters.
		☐	The project is a small facility with impervious cover of less than or equal to 1 acre.
		☒	The project has a post-development peak discharge rate from the facility that is less than 2 cfs for the 1-year, 24-hour Type III design storm event (prior to any attenuation). (Note: LID design strategies can greatly reduce the peak discharge rate).
☐	☒	Conveyance and natural channel protection for the site have been met. If "No,' explain why: **Under RIDISM Section 3, this project is considered a redevelopment site, therefore this standard is not required to be addressed.**	

TABLE 4-1: Summary of Channel Protection Volumes (see RICR 8.10) N/A					
Design Point	**Receiving Water Body Name**	**Coldwater Fishery? (Y/N)**	**Total CPv Required (cu ft)**	**Total CPv Provided (cu ft)**	**Average Release Rate Modeled in the 1-yr storm (cfs)**
TOTALS:					
Note: The Channel Protection Volume Standard must be met in each waterbody ID.					
☐ YES ☐ NO	The CPv is released at roughly a uniform rate over a 24-hour duration (see examples of sizing calculations in Appendix D of the RISDISM).				
☐ YES ☐ NO	Do additional design restrictions apply resulting from any discharge to cold-water fisheries; If "Yes," please indicate restrictions and solutions below.				
☐ Indicate below where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.). **N/A**					

OVERBANK FLOOD PROTECTION (RICR 8.11) AND OTHER POTENTIAL HIGH FLOWS – MINIMUM STANDARD 5			
YES	**NO**		
☒	☐	Is this standard waived? If yes, please indicate one or more of the reasons below:	
		☐	The project directs discharge to a large river (i.e., 4th-order stream or larger. See Appendix I for state-wide list and map of stream orders), bodies of water >50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters.
		☐	A Downstream Analysis (see RICR 8.11.D and E) indicates that peak discharge control would not be beneficial or would exacerbate peak flows in a downstream tributary of a particular site (e.g., through coincident peaks). **Under RIDISM Section 3, this project is considered a redevelopment site, therefore this standard is not required to be addressed.**
☒	☐	Does the project flow to an MS4 system or subject to other stormwater requirements? If "Yes," indicate as follows:	
		☒	RIDOT
		☐	Other (specify):
Note: The project could be approved by RIDEM but not meet RIDOT or Town standards. RIDOT's regulations indicate that post-volumes must be **less** than pre-volumes for the 10-yr storm at the design point entering the RIDOT system. If you have not already received approval for the discharge to an MS4, please explain below your strategy to comply with RIDEM and the MS4.			
		Indicate below which model was used for your analysis. ☐ TR-55 ☐ TR-20 ☒ HydroCAD ☐ Bentley/Haestad ☐ Intellisolve ☐ Other (Specify):	
YES	**NO**		
☐	☐	Does the drainage design demonstrate that flows from the 100-year storm event through a BMP will safely manage and convey the 100-year storm? If "No," please explain briefly below and reference where in the application further documentation can be found (i.e., name of report/document, page numbers, appendices, etc.):	
☐	☐	Do off-site areas contribute to the sub-watersheds and design points? If "Yes,"	
☐	☐	Are the areas modeled as "present condition" for both pre- and post-development analysis?	
☐	☐	Are the off-site areas shown on the subwatershed maps?	
☐	☐	Does the drainage design confirm safe passage of the 100-year flow through the site for off-site runoff?	
☐	☐	Is a Downstream Analysis required (see RICR 8.11.E.1)?	
☐	☐	Calculate the following:	
		☐	Area of disturbance within the sub-watershed (areas)
		☐	Impervious cover (%)
☐	☐	Is a dam breach analysis required (earthen embankments over six (6) feet in height, or a capacity of 15 acre-feet or more, and contributes to a significant or high hazard dam)?	
☐	☐	Does this project meet the overbank flood protection standard?	

Table 5-1 Hydraulic Analysis Summary								
Subwatershed (Design Point)	**1.2" Peak Flow** (cfs) **		**1-yr Peak Flow** (cfs)		**10-yr Peak Flow** (cfs)		**100-yr Peak Flow** (cfs)	
	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)
DP-1:	0.54	0.56	1.48	2.24	3.35	4.69	8.62	10.06
DP-2:	0.29	0.14	0.84	0.40	1.77	0.93	3.34	1.84
DP-3:	0.36	0.19	1.13	0.73	2.73	2.15	5.60	4.88
TOTALS:	1.19	0.89	3.45	3.37	7.85	7.77	17.56	16.78

** Utilize modified curve number method or split pervious /impervious method in HydroCAD.

Note: The hydraulic analysis must demonstrate no impact to each individual subwatershed DP unless each DP discharges to the same wetland or water resource.

Indicate as follows where the pertinent calculations and/or information for the items above are provided	**Name of report/document, page numbers, appendices, etc.**
Existing conditions analysis for each subwatershed, including curve numbers, times of concentration, runoff rates, volumes, and water surface elevations showing methodologies used and supporting calculations.	Section 3.5
Proposed conditions analysis for each subwatershed, including curve numbers, times of concentration, runoff rates, volumes, water surface elevations, and routing showing the methodologies used and supporting calculations.	Section 3.5
Final sizing calculations for structural stormwater BMPs, including contributing drainage area, storage, and outlet configuration.	N/A
Stage-storage, inflow and outflow hydrographs for storage facilities (e.g., detention, retention, or infiltration facilities).	Section A3.2

Table 5-2 Summary of Best Management Practices											
BMP ID	**DP #**	**BMP Type** (e.g., bioretention, tree filter)	**BMP Functions**					**Bypass Type**	**Horizontal Setback Criteria are met per RICR 8.21.B.10, 8.22.D.11, and 8.35.B.4**		
			Pre-Treatment (Y/N/ NA)	Re_v	WQ_v	CP_v (Y/N/ NA)	Overbank Flood Reduction (Y/N/NA)	External (E) Internal (I) or NA	Yes/ No	Technical Justification (Design Report page number)	Distance Provided
107P	DP-1	FocalPoint	Y	NA	Y	NA	NA	E	Yes	Section 2.3	35'
Bio-A	DP-1	Bioretention	N	NA	Y	NA	NA	NA	Yes	Section 2.3	90'
		TOTALS:									

Table 5.3 Summary of Soils to Evaluate Each BMP									
DP #	**BMP ID**	**BMP Type** (e.g., bioretention, tree filter)	**Soils Analysis for Each BMP**						
			Test Pit ID# and Ground Elevation		SHWT Elevation (ft)	Bottom of Practice Elevation* (ft)	Separation Distance Provided (ft)	Hydrologic Soil Group (A, B, C, D)	Exfiltration Rate Applied (in/hr)
			Primary	Secondary					
DP-1		FocalPoint	TH-1	TH-2	290.25	289.75	**	B/D	NA
		TOTALS:							

* For underground infiltration systems (UICs) bottom equals bottom of stone, for surface infiltration basins bottom equals bottom of basin, for filters bottom equals interface of storage and top of filter layer

**** System is lined with 30 mil PVC Liner with 8 ounce non-woven Geotextile underlayment and overlayment or approved equal fabric.. See plans prepared by DiPrete Engineering for details****

LAND USES WITH HIGHER POTENTIAL POLLUTANTS LOADS (LUHPPLs) – MINIMUM STANDARD 8			
YES	**NO**	**N/A**	
☒	☐	☐	Describe any LUHPPLs identified in Part 1, Minimum Standard 8, Section 2. If not applicable, continue to Minimum Standard 9.
☐	☒	☐	Are these activities already covered under an MSGP? If "No," please explain if you have applied for an MSGP or intend to do so?
☒	☐	☐	List the specific BMPs that are proposed for this project that receive stormwater from LUHPPL drainage areas. These BMP types must be listed in RISDISM Table 3-3, "Acceptable BMPs for Use at LUHPPLs." Please list BMPs: **Oil-Water Separator**
☐	☒	☐	Additional BMPs, or additional pretreatment BMP's if any, that meet RIPDES MSGP requirements; Please list BMPs:
			Indicate below where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.). **Design Plans & Stormwater Management Report by DiPrete Engineering**

ILLICIT DISCHARGES – MINIMUM STANDARD 9			
Illicit discharges are defined as unpermitted discharges to Waters of the State that do not consist entirely of stormwater or uncontaminated groundwater, except for certain discharges identified in the RIPDES Phase II Stormwater General Permit.			
YES	**NO**	**N/A**	
☒	☐	☐	Have you checked for illicit discharges?
☐	☒	☐	Have any been found and/or corrected? If "Yes," please identify.
☒	☐	☐	Does your report explain preventative measures that keep non-stormwater discharges out of the Waters of the State (during and after construction)?

SOIL EROSION AND SEDIMENT CONTROL (SESC) – MINIMUM STANDARD 10				
YES	**NO**	**N/A**		
☒	☐	☐	Have you included a Soil Erosion and Sediment Control Plan Set and/or Complete Construction Plan Set?	
☒	☐	☐	Have you provided a **separately-bound** document based upon the SESC Template? If yes, proceed to Minimum Standard 11 (the following items can be assumed to be addressed).	
			If "No," include a document with your submittal that addresses the following elements of an SESC Plan:	
			☐	Soil Erosion and Sediment Control Plan Project Narrative, including a description of how the fifteen (15) Performance Criteria have been met:
			☐	Provide Natural Buffers and Maintain Existing Vegetation
			☐	Minimize Area of Disturbance
			☐	Minimize the Disturbance of Steep Slopes
			☐	Preserve Topsoil
			☐	Stabilize Soils
			☐	Protect Storm Drain Inlets
			☐	Protect Storm Drain Outlets
			☐	Establish Temporary Controls for the Protection of Post-Construction Stormwater Control Measures
			☐	Establish Perimeter Controls and Sediment Barriers
			☐	Divert or Manage Run-On from Up-Gradient Areas
			☐	Properly Design Constructed Stormwater Conveyance Channels
			☐	Retain Sediment On-Site
			☐	Control Temporary Increases in Stormwater Velocity, Volume, and Peak Flows
			☐	Apply Construction Activity Pollution Prevention Control Measures
			☐	Install, Inspect, and Maintain Control Measures and Take Corrective Actions
			☐	Qualified SESC Plan Preparer's Information and Certification
			☐	Operator's Information and Certification; if not known at the time of application, the Operator must certify the SESC Plan upon selection and prior to initiating site activities
			☐	Description of Control Measures, such as Temporary Sediment Trapping and Conveyance Practices, including design calculations and supporting documentation, as required

STORMWATER MANAGEMENT SYSTEM OPERATION, MAINTENANCE, AND POLLUTION PREVENTION PLAN – MINIMUM STANDARDS 7 AND 9		
Operation and Maintenance Section		
YES	**NO**	
☒	☐	Have you minimized all sources of pollutant contact with stormwater runoff, to the maximum extent practicable?
☒	☐	Have you provided a **separately-bound** Operation and Maintenance Plan for the site and for all of the BMPs, and does it address each element of RICR 8.17 and RISDISM Appendix C and E?
☒	☐	Lawn, Garden, and Landscape Management meet the requirements of RISDISM Section G.7? If "No," why not?
☒	☐	Is the property owner or homeowner's association responsible for the stormwater maintenance of all BMP's? If "No," you must provide a legally binding and enforceable maintenance agreement (see RISDISM Appendix E, page 26) that identifies the entity that will be responsible for maintenance of the stormwater. Indicate where this agreement can be found in your report (i.e., name of report/document, page numbers, appendices, etc.).
☐	☒	Do you anticipate that you will need legal agreements related to the stormwater structures? (e.g. off-site easements, deed restrictions, covenants, or ELUR per the Remediation Regulations). If "Yes," have you obtained them? Or please explain your plan to obtain them:

☐	☒	Is stormwater being directed from public areas to private property? If "Yes," note the following: Note: This is not allowed unless a funding mechanism is in place to provide the finances for the long-term maintenance of the BMP and drainage, or a funding mechanism is demonstrated that can guarantee the long-term maintenance of a stormwater BMP by an individual homeowner.
Pollution Prevention Section		
☒	☐	Designated snow stockpile locations?
☒	☐	Trash racks to prevent floatables, trash, and debris from discharging to Waters of the State?
☒	☐	Asphalt-only based sealants?
☐	☒	Pet waste stations? (Note: If a receiving water has a bacterial impairment, and the project involves housing units, then this could be an important part of your pollution prevention plan).
☒	☐	Regular sweeping? Please describe: **See Operation and Maintenance Plan by DiPrete Engineering**
☒	☐	De-icing specifications, in accordance with RISDISM Appendix G. (NOTE: If the groundwater is GAA, or this area contributes to a drinking water supply, then this could be an important part of your pollution prevention plan).
☒	☐	A prohibition of phosphate-based fertilizers? (Note: If the site discharges to a phosphorus impaired waterbody, then this could be an important part of your pollution prevention plan).

PART 4. SUBWATERSHED MAPPING AND SITE-PLAN DETAILS

Existing and Proposed Subwatershed Mapping (REQUIRED)			
YES	**NO**		
☒	☐		Existing and proposed drainage area delineations
☒	☐		Locations of all streams and drainage swales
☒	☐		Drainage flow paths, mapped according to the DEM *Guidance for Preparation of Drainage Area Maps* (included in RISDISM Appendix K)
☒	☐		Complete drainage area boundaries; include off-site areas in both mapping and analyses, as applicable
☒	☐		Logs of borings and/or test pit investigations along with supporting soils/geotechnical report
☒	☐		Mapped seasonal high-water-table test pit locations
☐	☐		Mapped locations of the site-specific borings and/or test pits and soils information from the test pits at the locations of the BMPs
☒	☐		Mapped locations of the BMPs, with the BMPs consistently identified on the Site Construction Plans
☐	☒		Mapped bedrock outcrops adjacent to any infiltration BMP
☒	☐		Soils were logged by a:
		☒	DEM-licensed Class IV soil evaluator Name: Brandon B. Faneuf, #D4059
		☐	RI-registered P.E. Name:

Subwatershed and Impervious Area Summary				
Subwatershed (area to each design point)	**First Receiving Water ID or MS4**	**Area Disturbed (units)**	**Existing Impervious (units)**	**Proposed Impervious (units)**
DP-1:	Unnamed Trib to Meshanticut Brook	1.284	0.815	0.783
DP-2:	Plainfield Pike ROW	0.233	0.268	0.128
DP-3:	Plainfield Pike/ Sailor Way ROW	0.711	0.328	0.171
TOTALS:		2.228	1.411	1.082

Site Construction Plans (Indicate that the following applicable specifications are provided)		
YES	**NO**	
☒	☐	Existing and proposed plans (scale not greater than 1" = 40') with North arrow
☒	☐	Existing and proposed site topography (with 1 or 2-foot contours); 10-foot contours accepted for off-site areas
☒	☐	Boundaries of existing predominant vegetation and proposed limits of clearing
☒	☐	Site Location clarification
☒	☐	Location and field-verified boundaries of resource protection areas such as: ► freshwater and coastal wetlands, including lakes and ponds ► coastal shoreline features Perennial and intermittent streams, in addition to Areas Subject to Storm Flowage (ASSFs)
☒	☐	All required setbacks (e.g., buffers, water-supply wells, septic systems)
☒	☐	Representative cross-section and profile drawings, and notes and details of structural stormwater management practices and conveyances (i.e., storm drains, open channels, swales, etc.), which include: ► Location and size of the stormwater treatment practices (type of practice, depth, area). Stormwater treatment practices (BMPs) must have labels that correspond to RISDISM Table 5-2; ► Design water surface elevations (applicable storms); ► Structural details of outlet structures, embankments, spillways, stilling basins, grade-control structures, conveyance channels, etc.; ► Existing and proposed structural elevations (e.g., inverts of pipes, manholes, etc.); ► Location of floodplain and, if applicable, floodway limits and relationship of site to upstream and downstream properties or drainage that could be affected by work in the floodplain; ► Planting plans for structural stormwater BMPs, including species, size, planting methods, and maintenance requirements of proposed planting
☒	☐	Logs of borings and/or test pit investigations along with supporting soils/geotechnical report and corresponding water tables
☐	☒	Mapping of any OLRSMM-approved remedial actions/systems (including ELURs)
☒	☐	Location of existing and proposed roads, buildings, and other structures including limits of disturbance; ► Existing and proposed utilities (e.g., water, sewer, gas, electric) and easements; ► Location of existing and proposed conveyance systems, such as grass channels, swales, and storm drains, and location(s) of final discharge point(s) (wetland, waterbody, etc.); ► Cross sections of roadways, with edge details such as curbs and sidewalks; ► Location and dimensions of channel modifications, such as bridge or culvert crossings
☐	☒	Locations, cross sections, and profiles of all stream or wetland crossings and their method of stabilization

1.0 Project Description

The purpose of this report is to specify a Stormwater Management System for the proposed redevelopment at 2050 Plainfield Pike, Cranston, RI. A Stormwater System Operations and Maintenance Plan (O&M) has been prepared by DiPrete Engineering as a separate document.

The site has a total area of 1.72 acres and is located on Assessor's Plat 36 Lots 116 and 117 in Cranston Rhode Island. The site is located on the southwest corner of Plainfield Pike and Sailor Way. The existing building serves as an office and vehicle repair facility which will be demolished for this redevelopment. There are two existing cemeteries located near and on the property located northeast of the existing building which are to remain and be protected throughout this redevelopment. There is existing parking on the north and east sides of the building and in a satellite area east of the building and cemeteries with its own curb cut.

The stormwater quality will be improved by utilizing Best Management Practices (BMPs) as established by the RISDISM for the treatment of stormwater runoff from the proposed development. BMPs will consist of an oil-water separator for pretreatment and FocalPoint High Performance Modular Biofiltration System (HPBMS) with an ACF R-Tank underdrain and impermeable liner is used to treat the water quality storm and then conveyed to the existing drainage system. A portion of the site is also captured with a slot drain and conveyed to an existing bioretention area to treat the water quality storm then conveyed to the existing drainage system. The system has been designed to meet the RIDEM Stormwater Design and Installations Standards Manual.

2.0 Site Conditions

2.1 SOILS

There are the following soil types within the analyzed area of the Site as mapped by the NRCS USDA Soil Conservation service:

Soil Symbol	Description	Hydrologic Group
LgC	Lippitt gravelly sandy loam, very rocky, 3 to 15 percent slopes	B
NaB	Narragansett silt loam, 3 to 8 percent slopes	B
StA	Sutton fine sandy loam, 0 to 3 percent slopes	D
UD	Udorthents-Urban land complex	None
Ur	Urban land	None

Onsite soils classified as UD and Ur as assumed as Hydrologic Group D. Hydrologic Group B and D has been used for modeling the site.

Site specific soil evaluations can be found in Appendix A2.1.

2.2 EXISTING SITE CONDITIONS

Currently the site is predominately impervious with a single building serving as an office and vehicle maintenance facility. Stormwater southern portion of the site flows overland either to the existing bioretention area approved and constructed in 2013 under a previous RIDEM Permit Approval #OCTA 12-029. or bypasses and heads immediately downstream to the existing wetland located in the rear of the site. This wetland discharges to the 48" culvert running from west to east under Sailor Way which then connects to a combination of overland and underground drainage patterns tributary to Meshanticut Brook (Design Point 1). Stormwater from the northwest portion of the site flows overland north onto Plainfield Pike DOT ROW and then into catch basins in the ROW (Design Point 2). Stormwater from north and east portions on the site flow overland onto Sailor Way ROW, then flowing north towards the Plainfield Pike and Sailor Way Intersection and into catch basins in the ROW (Design Point 3).

2.3 POST SITE CONDITIONS

The proposed drainage analysis uses stormwater management systems to control and treat runoff from the proposed development. The following BMP's are used on site and have been designed to include the following elements:

- Bypass Structures
    - Directs water quality flow to the water quality BMP.
    - Bypass larger storms to the existing drainage network thus protecting the water quality BMP.
- Oil/Water Separator
    - Pretreatment of impervious areas for water quality stormwater event.
    - Positioned to accept all stormwater flow from the passenger fueling (LUHPPL) area.

- FocalPoint HPBMS and R-Tank Underdrain
    - Sized in accordance with the RIDEM Certification for the FocalPoint HPMBS, providing a filter bed of 121 sf and the approved infiltration rate of 100 in/hr
    - Lined with an impermeable liner to prevent infiltration due to site being a LUHPPL.
    - 3" mulch layer and 18" high flow layer utilized to fully treat the water quality stormwater event.
    - Approved removal rates of the following pollutants:
        - 85% removal of total suspended solids (TSS)
        - 60% removal of pathogens
        - 30% removal of total phosphorus
    - R-Tank underdrain wrapped with filter fabric
    - Setback to building foundation of 25' met (35' provided)
- Reuse of existing onsite bioretention
    - 1.0' of bioretention soil under rain garden for stormwater filtration
    - Maximum 9" of ponding
    - Setback to building foundation of 25' met (90' provided)

The above elements will used to meet the design standards of the Rhode Island Stormwater Design and Installation Standard.

3.0 Minimum Standards

The site has been designed to meet the minimum standards as outlined in the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM). The following sections outline how the site meets and exceeds the minimum required standards.

3.1 Minimum Standard 1: LID Site Planning and Design Strategies

Not applicable for redevelopment, per RISDISM Section 3.

3.2 Minimum Standard 2: Groundwater Recharge

Groundwater is to be recharged per watershed based on impervious area coverage in accordance with section 3.2.2 of the RISDISM.

Groundwater recharge is determined from the following equation:

Re_v=1”*F*I/12

Where:

Re_v=Groundwater Recharge Volume (cf)

F=Recharge Factor based on Hydrologic Soil Groups (HSG) (see table below)

I=Impervious Area (sf)

HSG	Recharge Factor (F)
A	0.60
B	0.35
C	0.25
D	0.10

The proposed use is an auto fueling facility, which falls under a LUHPPL classification. Because of this infiltration is not proposed at this site, therefore the stormwater recharge requirement is unable to be met. See Appendix 2.1 for more information.

3.3 Minimum Standard 3: Water Quality

The site proposes to reduce impervious area and provide water quality for at least 50% of the proposed impervious area. A portion of the site was developed in a parking expansion in 2013, which will be treated for 100% water quality treatment. Captured stormwater is treated through an approved BMP before being discharged. This site has been designed to use a bypass manhole to direct the water quality storm into the FocalPoint HPBMS or the existing bioretention area to treat stormwater before being discharged. Refer to the Impervious Calculation Map included in the Appendix.

Water Quality System

The Water Quality System has been designed as a FocalPoint HPBMS over an R-Tank Underdrain. The system has been sized using FocalPoint design guidelines and HydroCAD. The filtration rate of 100 in/hr was used because of the high flow-rate engineered soil media. See Appendix A3.2 for the HydroCAD analysis of the water quality event. The Water Quality system has been designed to fully treat the water quality storm event. Water Quality Calculations are shown below.

Total Existing Impervious Area:	1.411 acres
Existing Impervious Area PST-3	0.251 acres
Total Existing Impervious for 2022 Redevelopment	1.411-0.251=1.160 acres
Proposed Impervious Area:	1.082 acres
Impervious Reduction:	1.411 –1.082 = 0.329 acres
WQ Required (Redevelopment):	1.160 * 50% = 0.580 acres

Total WQ Required:

2022 Redevelopment + Previous redevelopment
+ Impervious Reduction: 0.580 + 0.251 – 0.329 = 0.502 acres

<u>Water Quality System</u>

Water Quality Volume (WQ_V) = 1" x Impervious Area

(WQ_V) = **1,822 cubic feet (cf)**

Required WQ_V = 75% of WQ_V must be held within system

Required (WQ_V) = **1,367 cf**

Provided (WQ_V) = **208 cf @ 292.75** (See storage tables in Appendix 3.2)

Despite the FocalPoint HPBMS not providing the minimum temporary water quality storage, it should be noted that the increased filtration rate compensates for the smaller temporary water quality storage. This specific concern was highlighted and addressed in the RIDEM Certification of the FocalPoint HPBMS, issued October 4, 2021: "….the device in and of itself does not meet minimum requirements for filter bed area or minimum temporary water quality storage. However, the increased infiltration rate compensates for the device's smaller filter bed area and temporary storage. The manufacturer has

demonstrated through the provided field studies that the device provides the minimum water quality pollutant removal rates specified in Stormwater Rule 250-RICR-150-10-8.9B."

The FocalPoint HPBMS system has been designed in accordance with RIDEM requirements. Please see Appendix A3.2.1 for a copy of a certification of design compliance from Ferguson Waterworks and the RIDEM certification. Per the above mentioned RIDEM Certification, the filter bed of the FocalPoint must be sized to provide 192 sf of filter bed area per acre of impervious cover. Of the 0.642 acres tributary to the FocalPoint, 0.515 acres are impervious for a requirement minimum size of 109 sf. The provided filter bed area is 121 sf.

Though not needed to meet the water quality requirement, the existing bioretention area on the southern portion of the site is to be maintained and reused. This bioretention area was designed to treat a total of 0.378 acres with 0.227 acres of impervious area. Under proposed conditions only 0.124 acres with 0.112 acres of impervious area are routed to the bioretention area for treatment.

Design Point 1 discharges stormwater to an unnamed tributary to the Meshanticut Brook (Waterbody ID RI0006017R-02), located underground approximately 400 feet to the southeast, which has a TMDL for Enterococcus Bacteria with a "year reported" date of 2022 per the RIDEM Website.
Proposed BMPs in the Design Point 1 treatment train include vacuum/ street sweeping, an existing bioretention system and a new FocalPoint HPBMs (also considered bioretention). Street sweeping and bioretention are attributed 15% and 70% bacteria removal rates respectively, providing a net bacteria removal efficiency of 75% which is greater than the estimated TMDL removal target of 73% per Table 8-1 of the RI TMDL for Bacteria Impaired Waters (September 2011).

3.4 Minimum Standard 4: Conveyance and Natural Channel Protection

Under RIDISM Section 3, this project is considered a redevelopment site, therefore this minimum standard is not required to be addressed.

3.4.1 Drainage Network Design Parameters:

A. PIPES

- All drainage pipes are HDPE or equivalent unless otherwise noted.
- Manning's coefficient = 0.012 for HDPE Pipe
- Diameters & lengths as specified
- The 100-year design storm is utilized for the drainage pipe design to ensure that the drainage system contains and channels water to the BMP areas as shown on the plans.
- The rational method has been used for the closed drainage system.

B. STRUCTURES

- Catch basins – Pre-cast concrete with 3' sump unless otherwise noted and inverts as specified
- Manholes – Pre-cast concrete with inverts as specified.

3.5 Minimum Standard 5: Overbank Flood Protection & Downstream Analysis

3.5.1 Method of Analysis

USDA Soil Conservation Service Method as defined by Technical Release No. 20 (TR-20) determines Stormwater runoff rate and volume. Type III rainfall distribution is utilized. Time of concentration is determined using Technical Release No 55 (TR-55) methodology, through the computer program *HydroCAD ver. 10.0* by HydroCAD Software Solutions LLC.

The drainage system has been designed to mitigate all stormwater flows for the 25 and 100 year storm events. The emergency outlets have been sized to handle the 100 year storm event.

3.5.2 Design Storm

Analysis of 1-year, 2-year 10-year, 25-year, and 100-year frequency 24-hour storms are included. The following 24-hour rainfall intensities are obtained from the Rhode Island Stormwater Design and Installation Standards Manual, Table 3-1 for Providence County.

1 year =	2.7 inches
2 year =	3.3 inches
10 year =	4.9 inches
25 year =	6.1 inches
100 year=	8.7 inches

3.5.3 Design Point Breakdown

The site is analyzed as 25 watershed areas. In the pre development stage there are 10 subcatchments. In the post development stage there are 15 subcatchments. A description of each watershed and associated subcatchments are summarized as follows, for cover types see color watershed maps located in back of this report. Numbers in parentheses ( ) indicate the HydroCAD Node Number.

<u>Design Point 1:</u>

Design Point 1 (15, 116) represents the discharge to the southeast of the site, tributary to the Meshanticut Brook.

In pre development conditions there are 7 sub watersheds:

Pre-10 (10) represents the existing impervious area in which the stormwater flows to an existing catch basin and is conveyed to the existing wetland which is routed under Sailor Way to Design Point 1.

Pre-11 (11) represents the existing impervious area in which the stormwater flows to two existing catch basins and is conveyed to the existing wetland which is routed under Sailor Way to Design Point 1.

Pre-12 (12) represents the existing building in which stormwater is discharged to the existing grade and flows overland to the existing wetland which is routed under Sailor Way to Design Point 1.

Pre-13 (13) represents the existing wetlands which stormwater flows overland to the existing wetland which is routed under Sailor Way to Design Point 1.

Pre-14 (14) represents the existing impervious area which stormwater flows overland to a culvert which is routed under Sailor Way to Design Point 1.

Existing Site (PST-2) represents the onsite area which bypasses the existing bioretention area. Pre-2 is predominantly impervious. Stormwater flows overland to the existing wetland and is routed under Sailor Way to Design Point 1.

Proposed Conditions (PST-3) represents the onsite area which flow to the existing bioretention area. Pre-3 is predominantly impervious. The stormwater is routed to the bioretention area and flows under Sailor Way to Design Point 1.

In post development conditions there are 11 sub watersheds:
Post-100 (100) represents the proposed fueling canopy which is collected through a series of roof leaders which is routed underground through an oil/water separator and to Focal Point. Stormwater discharges to the existing wetland which is routed under Sailor Way to Design Point 1.
Post-101 (101) represents the impervious area between the fueling canopy and the proposed building. Stormwater is collected in a trench drain which is routed underground through an oil/water separator and to Focal Point. Stormwater discharges to the existing wetland which is routed under Sailor Way to Design Point 1.
Post-102 (102) represents the proposed building area. Stormwater is collected through a series of roof leaders which is routed underground through an oil/water separator and to Focal Point. Stormwater discharges to the existing wetland which is routed under Sailor Way to Design Point 1.
Post-103 (103) represents the predominantly impervious onsite area and runoff from the abutting western property. Stormwater is collected in two catch basins and is routed underground through an oil/water separator and to Focal Point. Stormwater discharges to the existing wetland which is routed under Sailor Way to Design Point 1.
Post-104 (104) represents the grassed area above the focal point. Stormwater is collected in the depression above the focal point in which water flows through the Focal Point and flows underground to the existing wetland where stormwater is routed under Sailor Way to Design Point 1.
Post-109 (109) represents the impervious driveway area. Stormwater flows overland into Sailor Way and is discharged to Design Point 1.
Post-110 (110) represent the impervious area, including a smaller fueling canopy in the southern portion of the site. Stormwater is collected in a trench drain and is routed to the bioretention area. Stormwater ultimately overflows to the existing wetland and is routed under Sailor Way to Design Point 1.
Post-111 (111) represent the predominantly grassed area in the southern portion of the site. Stormwater flows overland to the existing wetland and is routed under Sailor Way to Design Point 1.
Post-112 (112) represents the existing wetlands which stormwater flows overland to the existing wetland which is routed under Sailor Way to Design Point 1.
Post-113 (113) represents the impervious area to the northeast of the proposed fueling canopy. Stormwater is collected in an existing catch basin and is routed to the existing wetland where stormwater is routed under Sailor Way to Design Point 1.
Post-114 (114) represents the predominantly impervious area in the northeast portion of the site. Stormwater is collected and flows through an existing culvert under Sailor Way to Design Point 1.

Below is a summary of the hydrologic parameters for the pre and post development sub-areas in Design Point-1.

	Area (acres)	CN	Tc (min)
Pre-10	0.022	98	6.0
Pre-11	0.019	98	6.0
Pre-12	0.168	98	6.0
Pre-13	0.162	75	6.0
Pre-14	0.088	92	6.0

PST-2	0.224	97	6.0
PST-3	0.378	95	6.0
Post-100	0.078	98	6.0
Post-101	0.124	98	6.0
Post-102	0.123	98	6.0
Post-103	0.279	94	6.0
Post-104	0.037	61	6.0
Post-109	0.037	98	6.0
Post-110	0.124	95	6.0
Post-111	0.156	72	6.0
Post-112	0.157	76	6.0
Post-113	0.055	98	6.0
Post-114	0.114	90	6.0

Design Point 2:
Design Point 2 (21, 201) represents the discharge towards the existing catch basin in Plainfield Pike.

In pre development conditions there is 1 sub watersheds:
Pre-20 (20) represents the existing impervious, gravel and grassed area in the northwest portion of the site. Stormwater flows overland to an existing catch basin in Plainfield Pike to Design Point 2.

In post development conditions there is 1 sub watersheds:
Post-200 (200) represents the proposed impervious, gravel and grassed area in the northwest portion of the site. Stormwater flows overland to an existing catch basin in Plainfield Pike to Design Point 2.

Below is a summary of the hydrologic parameters for the pre and post development sub-areas in Design Point-2.

	Area (acres)	CN	Tc (min)
Pre-20	0.405	91	6.0
Post-200	0.233	87	6.0

Design Point 3:
Design Point 3 (32, 303) represents the discharge towards the existing catch basins located in the intersection of Plainfield Pike and Sailor Way.

In pre development conditions there are 2 sub watersheds:
Pre-30 (30) represents the predominantly grassed area of the site. Stormwater flows overland to the catch basins located in Plainfield Pike to Design Point 3.
Pre-31 (31) represents the predominantly impervious area the eastern portion of the site. Stormwater flows overland to the catch basins located in Sailor Way to Design Point 3.

In post development conditions there are 3 sub watersheds:
Post-300 (300) represents the predominantly grassed area of the site. Stormwater flows overland to the catch basins located in Plainfield Pike to Design Point 3.

Pre-301 (301) represents the grassed and impervious area the eastern portion of the site. Stormwater flows overland to the catch basins located in Sailor Way to Design Point 3.
Pre-302 (302) represents the predominantly impervious area. The two existing catch basins in the subcatchments will be converted to manhole covers and not accept stormwater. Stormwater will flow overland to the catch basins located in Sailor Way to Design Point 3.

Below is a summary of the hydrologic parameters for the pre and post development sub-areas in Design Point-3.

	Area (acres)	CN	Tc (min)
Pre-30	0.414	79	6.0
Pre-31	0.321	91	6.0
Post-300	0.325	74	6.0
Post-301	0.308	77	6.0
Post-302	0.079	95	6.0

The tables below presents a summary of the pre development flows vs. the mitigated post development flows. The table shows a decrease in the rate of runoff for all storms included in the analysis.

Pre Development vs. Post Development Mitigated Peak Flows

The tables below present a summary of the predevelopment flows vs. the mitigated post development flows.

Southeast Discharge: (DP-1)

Conditions – Peak Flow	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.54	1.48	1.88	3.35	5.48	8.62
Post Dev	0.56	2.24	2.89	4.69	6.73	10.06
Net Change	**0.02**	**0.76**	**1.01**	**1.34**	**1.25**	**1.44**

All flows in cubic feet per second (cfs)

Plainfield Pike CB: (DP-2)

Conditions – Peak Flow	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.29	0.84	1.10	1.77	2.27	3.34
Post Dev	0.14	0.40	0.55	0.93	1.22	1.84
Net Change	**-0.15**	**-0.44**	**-0.55**	**-0.84**	**-1.05**	**-1.50**

All flows in cubic feet per second (cfs)

Plainfield Pike/Sailor Way Intersection CBs: (DP-3)

Conditions – Peak Flow	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.36	1.13	1.55	2.73	3.63	5.60
Post Dev	0.19	0.73	1.09	2.15	2.99	4.88
Net Change	**-0.17**	**-0.40**	**-0.46**	**-0.58**	**-0.64**	**-0.72**

All flows in cubic feet per second (cfs)

Totals:

Conditions – Peak Flow	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	1.19	3.45	4.53	7.85	11.38	17.56
Post Dev	0.89	3.37	4.53	7.77	10.94	16.78
Net Change	**-0.30**	**-0.08**	**0.00**	**-0.08**	**-0.44**	**-0.78**

As described in the above tables, there is a decrease in flow to Design Points 2 and 3 from pre to post development in all storms but an increase in flow to Design Point 1 from pre to post development in all storms. This increase in peak flow is caused by the need to capture the majority of the site impervious for water quality treatment. Due to the existing high groundwater, the site being a LUHPPL restricting onsite infiltration and an existing shallow drainage connection point, onsite detention to reduce the peak flow for DP-1 is unable to be provided. The existing wetland at the rear of the site also recipient to these flows is an isolated forested area within a commercial landscape with three other offsite discharges into the wetland from the Cadence property to the west. The surrounding commercial area and urban runoff therefore significantly limits the value of this wetland.

According to the Streamstats Report (See Appendix A3.5.4.9) for this area, the subject property with a disturbance of 1.61 acres is only 3.4% of the 47.232 drainage area so the proposed increase in flow by this redevelopment will have a negligible effect on the overall catchment. It should be noted that the site drains directly to the 48” culvert which is the discharge point for the overall catchment. Due to this close proximity, Stormwater flows from the site will make it to and through the culvert before the greater (tributary) catchment peak flow arrives as the longest drainage path within the catchment is 0.64 miles.

In addition, the redevelopment proposes to remove the parking and stone storage area which was installed in 2013 under a previous RIDEM Permit Approval #OCTA 12-029 as part of the application to fill a freshwater wetland (See Appendices A3.5.4.7 and A3.5.4.8). The removal of these areas will increase the separation from the developed portion of the site from the existing wetland.

Given the factors and considerations listed above, the minor increases in flow to Design Point 1 are not considered to detrimentally affect downstream areas.

Pre Development vs. Post Development Mitigated Volume to DOT ROW

The tables below present a summary of the predevelopment volumes vs. the mitigated post development volumes for the Design Points affecting the DOT ROW. The tables show a decrease in stormwater runoff volume for all storms included in the analysis.

Plainfield Pike CB: (DP-2)

Conditions – Volume	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.023	0.061	0.079	0.131	0.171	0.257
Post Dev	0.011	0.029	0.039	0.067	0.089	0.138
Net Change	**-0.012**	**-0.032**	**-0.040**	**-0.064**	**-0.082**	**-0.119**

All volumes in acre-feet (ac-ft)

Plainfield Pike/Sailor Way Intersection CBs: (DP-3)

Conditions – Volume	WQ Storm	1-Year	2-Year	10-Year	25-Year	100-Year
Pre Dev	0.036	0.082	0.112	0.198	0.266	0.417
Post Dev	0.016	0.056	0.081	0.155	0.216	0.355
Net Change	**-0.020**	**-0.026**	**-0.031**	**-0.043**	**-0.050**	**-0.062**

All volumes in acre-feet (ac-ft)

3.5.5 Downstream Analysis

A downstream analysis is required under the following conditions:

Area of Disturbance (Acres)	Impervious Cover (%)
>5 to 10	>75
>10 to 25	>50
>25 to 50	>25
>50	All Projects

The proposed project analyzes 2.228 acres and has 1.082 acres of impervious. This is approximately 48.6% impervious cover. A downstream analysis is not required.

3.6 Minimum Standard 6: Redevelopment and Infill Projects.

This site is a redevelopment project. See Minimum Standard 6 in the Appendix A checklist.

3.7 Minimum Standard 7: Pollution Prevention

A Soil Erosion and Sediment Control Plan (SESC) for this development can be found under a separate document. See the Soil Erosion and Sediment Control Plan for the development prepared by DiPrete Engineering. The SESC contains information for construction pollution prevention. For post construction pollution prevention see the Operations and Maintenance (O&M) document prepared for this development by DiPrete Engineering.

3.8 Minimum Standard 8: Land Uses with High Potential Pollutant Loads (LUHPPLs)

Per RISDISM SECTION 3.2.8 Guidance for Infiltration at Auto Fueling Facilities, auto fueling is characterized as a LUHPPL. The LUHPPL portion of an auto fueling facility is the fuel dispensing area and the tank filling area (tank traffic mat). Stormwater runoff from these areas will be pre-treated by an oil/ water separator, in compliance with the Guidance document. The site has also been graded to isolate stormwater runoff from these areas to the maximum extent practicable, in order to isolate that section of the drainage network in the event of a spill. As shown on the plans, the oil/ water separator will be fitted with an emergency shutoff valve.

3.9 Minimum Standard 9: Illicit Discharges

There are no proposed Illicit Discharges on site. The site will be serviced by public water and sewer.

3.10 Minimum Standard 10: Construction Activity Soil Erosion, Runoff and Sedimentation and Pollution Prevention Control Measure Requirements

See the SESC for this development prepared by DiPrete Engineering.

3.11 Minimum Standard 11: Stormwater Management System Operation and Maintenance

See the O&M for this development prepared by DiPrete Engineering.

Appendix A

A2.1 Soil Evaluations

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources

Stormwater Evaluation Form
Part A – Soil Profile Description **Application Number** N/A

Property Owner: DSD Enterprises LLC
Property Location: 2050 Plainfield Pike Cranston, RI / A.P. 36/2, Lot 117
Date of Test Hole: April 2, 2022
Soil Evaluator: Brandon B. Faneuf License Number: D4059
Weather: Sunny, 35ºF Shaded: Yes ☐ No ☒ Time: 7:30 am

TH 1 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox	Texture	Structure	Consistence	Rawls rate: (Table 5-3 Inches/hr)
		Dist	Topo	Matrix	Re-Dox Features	Ab. S. Contr.				
M	0-4	A	S	-	-	-	-	-	-	-
^C1	4-19	A	S	2.5Y 5/4	-	-	cosl	0/ma	fr	1.02
^C2	19-46	A	S	5Y 6/1	-	-	sl	0/ma	fr	1.02
Ab	46-56	C	W	10YR 2/2	-	-	fsl	1/sbk	vfr	1.02
Bwb	56-74	C	W	2.5Y 5/3	-	-	fsl	1/sbk	vfr	1.02
C	74-96	-	-	2.5Y 6/2	-	-	stsl	0/ma	fr	1.02
TH 2 Horizon	**Depth**	**Horizon Boundaries**		**Soil Colors**		**Re-Dox**	**Texture**	**Structure**	**Consistence**	**Rawls rate: (Table 5-3 Inches/hr)**
		Dist	**Topo**	**Matrix**	**Re-Dox Features**	**Ab. S. Contr.**				
M	0-4	A	S	-	-	-	-	-	-	-
^C	4-36	A	S	2.5Y 5/1	-	-	cosl	0/ma	fr	1.02
Cr1	36-50	C	W	Rotten	Rock	-	-	-	-	-
C	50-72	C	W	5Y 6/1 5YR 3/4	-	-	fsl	0/ma	fr	1.02
Cr2	72-96	-	-	Rotten	Rock	-	-	-	-	-

TH 1 Soil Class HTM/ablation Total Depth 96" Impervious/Limiting Layer Depth - (eg) GW Seepage Depth 84" SHWT 57" (eg)

TH 2 Soil Class HTM/ablation Total Depth 96" Impervious/Limiting Layer Depth 36" (eg) GW Seepage Depth 60" SHWT 33" (eg)

Comments: Site is a paved parking area.

Completed soil evaluation inside of test hole for top 60" of soil. Analyzed soil from 60" to 96" from top of hole using excavator bucket samples.

TH2: Cr1 and Cr2 are rotten rock. Material breaks up into gravel with pressure.

Part B

Site Evaluation – to be completed by Soil Evaluator or Class II or III Designer

Please use the area below to locate:

1. Test holes and bedrock test holes,
2. Approximate direction of due north,
3. Offsets from all test holes to fixed points such as street, utility pole, or other permanent, marked object.*
   ***OFFSETS MUST BE SHOWN**

Key:

- Approximate location of test holes
- Approximate location of bedrock test holes
- x% Estimated gradient and direction of slope
- N Approximate direction of due north

See Attached

Bedrock THs	
TH	Depth

1. Relief and Slope: TH1: 3%, 130º TH2: 3%, 190º
2. Presence of any watercourse, wetlands or surface water bodies, within 200 feet of test holes? If yes, locate on above sketch. NO ☐ YES ☒
3. Restrictive Layer or Bedrock within 4' below original ground within 25 feet of test hole? Provide all test hole locations & depths above. NO ☐ YES ☒
4. Presence of existing or proposed private drinking water wells within 200 feet of test holes? If yes, locate on above sketch. NO ☒ YES ☐
5. Public drinking water wells within 500 feet of test holes? If yes, locate on above sketch. NO ☒ YES ☐
6. Is site within the watershed of a public drinking water reservoir or other critical area defined in Rule 38? NO ☒ YES ☐
7. Has soil been excavated from or fill deposited on site? If yes, locate on above sketch. NO ☐ YES ☒
8. Site's potential for flooding or ponding: NONE ☒ SLIGHT ☐ MODERATE ☐ SEVERE ☐
9. Landscape position: TH1: summit TH2: shoulder
10. Vegetation: none (parking lot)
11. Indicate approximate location of property lines and roadways
12. Additional comments, site constraints or additional information regarding site:

Certification

The undersigned hereby certifies that all information on this application and accompanying forms, submittals and sketches are true and accurate and that I have been authorized by the owner(s) to conduct these necessary field investigations and submit this request.

Part A prepared by: Brandon Fancuf (Signature) D4059 (License #) Part B prepared by: Brandon Fancuf (Signature) D4059 (License #)

DO NOT WRITE IN THIS SPACE

Witnessed Soil Evaluation Decision: Concur ☐ Inconclusive ☐ Disclaim ☐

Unwitnessed Soil Evaluations Decision: Accept ☐ Inconclusive ☐ Disclaim ☐

Wet Season Determination required ☐ **Additional Field Review Required** ☐

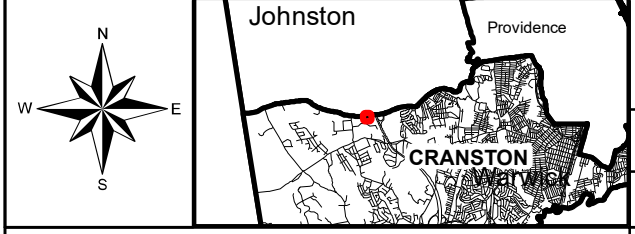
Explanation:

Signature Authorized Agent

Date

Ecosystem Solutions, Inc.
100 Centerville Rd., Suite 4 Warwick, RI 02886

FIGURE 1



Test Hole Locations
2050 Plainfield Pike / A.P. 36/2, Lot 117
Cranston, Rhode Island

DATE:	04-12-2022	PROJECT #:	SE22-538
CREATED BY:	GL	SCALE:	1 inch = 50 feet

2021 (March) Aerial Orthophoto
NRCS-USDA Soils Overlay

RIGIS 20

0 20 40 80 120 Feet

A3.2 Water Quality HydroCAD Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: Pre-10 Runoff Area=0.022 ac 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.02 cfs 0.002 af

Subcatchment 11: Pre-11 Runoff Area=0.019 ac 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.02 cfs 0.002 af

Subcatchment 12: Pre-12 Runoff Area=0.168 ac 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.18 cfs 0.014 af

Subcatchment 13: Pre-13 Runoff Area=0.162 ac 0.36% Impervious Runoff Depth=0.08"
Tc=6.0 min CN=75/98 Runoff=0.00 cfs 0.001 af

Subcatchment 14: Pre-14 Runoff Area=0.088 ac 67.03% Impervious Runoff Depth=0.71"
Tc=6.0 min CN=80/98 Runoff=0.07 cfs 0.005 af

Subcatchment 20: Pre-20 Runoff Area=0.405 ac 66.06% Impervious Runoff Depth=0.68"
Tc=6.0 min CN=76/98 Runoff=0.29 cfs 0.023 af

Subcatchment 30: Pre-30 Runoff Area=0.414 ac 22.28% Impervious Runoff Depth=0.26"
Tc=6.0 min CN=73/98 Runoff=0.10 cfs 0.009 af

Subcatchment 31: Pre-31 Runoff Area=0.323 ac 73.15% Impervious Runoff Depth=0.73"
Tc=6.0 min CN=72/98 Runoff=0.26 cfs 0.020 af

Link 15: DP-1 Brook Across Sailor Way Inflow=0.30 cfs 0.023 af
Primary=0.30 cfs 0.023 af

Link 21: DP-2 Plainfield Pike CB Inflow=0.29 cfs 0.023 af
Primary=0.29 cfs 0.023 af

Link 32: DP-3 Plainfield/Sailor Intersection CBs Inflow=0.36 cfs 0.029 af
Primary=0.36 cfs 0.029 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Pst-2: Existing Site Runoff Area=0.224 ac 95.98% Impervious Runoff Depth=0.95"
Tc=6.0 min CN=74/98 Runoff=0.24 cfs 0.018 af

Subcatchment Pst-3: Proposed Conditions Runoff Area=0.378 ac 87.83% Impervious Runoff Depth=0.87"
Tc=6.0 min CN=74/98 Runoff=0.36 cfs 0.028 af

Reach DP-1: Design Point Inflow=0.24 cfs 0.040 af
Outflow=0.24 cfs 0.040 af

Pond Bio-A: Bio - A Peak Elev=292.12' Storage=332 cf Inflow=0.16 cfs 0.023 af
Outflow=0.04 cfs 0.023 af

Pond Culvert: EX 48" Culvert Peak Elev=284.83' Storage=0.000 af Inflow=0.24 cfs 0.040 af
48.0" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=0.24 cfs 0.040 af

Pond FB: Sediment Forebay Peak Elev=292.54' Storage=213 cf Inflow=0.16 cfs 0.028 af
Outflow=0.16 cfs 0.023 af

Pond ST: Stone Storage Area Peak Elev=291.45' Storage=351 cf Inflow=0.36 cfs 0.028 af
Outflow=0.16 cfs 0.028 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100: Post-100 Runoff Area=0.078 ac 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.09 cfs 0.006 af

Subcatchment 101: Post-101 Runoff Area=0.123 ac 99.09% Impervious Runoff Depth=0.98"
Tc=6.0 min CN=80/98 Runoff=0.13 cfs 0.010 af

Subcatchment 102: Post-102 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.14 cfs 0.010 af

Subcatchment 103: Post-103 Runoff Area=0.280 ac 68.27% Impervious Runoff Depth=0.77"
Tc=6.0 min CN=86/98 Runoff=0.24 cfs 0.018 af

Subcatchment 104: Post-104 Runoff Area=0.037 ac 1.00% Impervious Runoff Depth=0.01"
Tc=6.0 min CN=61/98 Runoff=0.00 cfs 0.000 af

Subcatchment 109: Post-109 Runoff Area=0.037 ac 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.04 cfs 0.003 af

Subcatchment 110: Post-110 Runoff Area=0.124 ac 91.05% Impervious Runoff Depth=0.90"
Tc=6.0 min CN=61/98 Runoff=0.12 cfs 0.009 af

Subcatchment 111: Post-111 Runoff Area=0.156 ac 0.00% Impervious Runoff Depth=0.04"
Tc=6.0 min CN=72/0 Runoff=0.00 cfs 0.001 af

Subcatchment 112: Post-112 Runoff Area=0.157 ac 0.29% Impervious Runoff Depth=0.09"
Tc=6.0 min CN=76/98 Runoff=0.01 cfs 0.001 af

Subcatchment 113: Post-113 Runoff Area=0.055 ac 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.06 cfs 0.005 af

Subcatchment 114: Post-114 Runoff Area=0.114 ac 55.50% Impervious Runoff Depth=0.62"
Tc=6.0 min CN=80/98 Runoff=0.07 cfs 0.006 af

Subcatchment 200: Post-200 Runoff Area=0.233 ac 55.05% Impervious Runoff Depth=0.57"
Tc=6.0 min CN=73/98 Runoff=0.14 cfs 0.011 af

Subcatchment 300: Post-300 Runoff Area=0.326 ac 0.70% Impervious Runoff Depth=0.06"
Tc=6.0 min CN=73/98 Runoff=0.00 cfs 0.002 af

Subcatchment 301: Post-301 Runoff Area=0.307 ac 31.52% Impervious Runoff Depth=0.32"
Tc=6.0 min CN=67/98 Runoff=0.11 cfs 0.008 af

Subcatchment 302: Post-302 Runoff Area=0.078 ac 91.26% Impervious Runoff Depth=0.90"
Tc=6.0 min CN=61/98 Runoff=0.08 cfs 0.006 af

Reach 108R: 18" FES Inflow=0.37 cfs 0.045 af
Outflow=0.37 cfs 0.045 af

Reach 115R: Culvert Avg. Flow Depth=0.09' Max Vel=2.04 fps Inflow=0.07 cfs 0.006 af
12.00" Round Pipe n=0.011 L=72.0' S=0.0100 '/' Capacity=4.21 cfs Outflow=0.07 cfs 0.006 af

Pond 105P: Bypass MH Peak Elev=293.36' Inflow=0.59 cfs 0.045 af
Primary=0.51 cfs 0.044 af Secondary=0.09 cfs 0.000 af Outflow=0.59 cfs 0.045 af

Pond 107P: FocalPoint 121sf Peak Elev=292.48' Storage=140 cf Inflow=0.51 cfs 0.044 af
Outflow=0.28 cfs 0.044 af

Pond Bio-A: Bio - A Peak Elev=291.05' Storage=115 cf Inflow=0.12 cfs 0.009 af
Outflow=0.02 cfs 0.009 af

Pond Culvert: EX 48" Culvert Peak Elev=284.89' Inflow=0.44 cfs 0.060 af
48.00" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=0.44 cfs 0.060 af

Link 116: DP-1 Brook Across Sailor Way Inflow=0.56 cfs 0.069 af
Primary=0.56 cfs 0.069 af

Link 201: DP-2 Plainfield Pike CB Inflow=0.14 cfs 0.011 af
Primary=0.14 cfs 0.011 af

Link 303: DP-3 Plainfield/Sailor Intersection CBs Inflow=0.19 cfs 0.016 af
Primary=0.19 cfs 0.016 af

A3.2.1 FocalPoint HPBMS Design Certification & RIDEM Certification

Rhode Island Department of Environmental Management

Office of Water Resources – Stormwater Technology Review Committee
235 Promenade St. Providence, RI 02908 Ph: 401-222-4700

Alternative Stormwater Technology Program

Vendor Information:
Convergent Water Technologies
13810 Hollister Road
Houston, TX 77086

Contact:
W. Scott Gorneau, P.E.
Vice President
Email: sgorneau@convergentwater.com
Web: www.convergentwater.com
Phone: 207-885-6174

Technology Name:
FocalPoint High Performance Modular Biofiltration System (HPMBS)

Approval Type:
WQBMP, Retrofits, Pre-Treatment

Certification Dates:
Issued: October 4, 2021
Expires: October 4, 2026

CERTIFICATION:

The Rhode Island Stormwater Technology Review Committee which consists of members from the Department of Environmental Management (DEM), Department of Transportation (DOT) and the Coastal Resources Management Council (CRMC) have reviewed the **FocalPoint** High Performance Modular Biofiltration System (HPMBS) application for Technology Approval and accepted use for Stormwater Treatment in the State of Rhode Island.

In accordance with Stormwater Rule 250-RICR-150-10-8.9B, **Convergent Water Technologies** has petitioned the permitting agencies to add the **FocalPoint** HPMBS to the list of acceptable structural stormwater controls described in Sections 8.19 through 8.25 of Stormwater Rule 250-RICR-150-10. They have submitted monitoring results and supporting information developed in accordance with the provisions of the Technology Assessment Protocol for Innovate and Emerging Technologies as described in Stormwater Rule 250-RICR-150-10 Sections 8.39 and 8.40.

The **FocalPoint** HPMBS is granted reciprocity in Rhode Island as a proprietary stormwater treatment technology, given that it has been certified by other State agencies which are members of the Technology Acceptance Reciprocity Partnership. The device was certified by the Maryland Department of Environment as a micro-bioretention practice in September of 2018. The Pennsylvania Department of Environmental Protection has also certified the device as a constructed filter approved for stand-alone treatment on new construction projects. Additionally, the Virginia Department of Environmental Quality certified the **FocalPoint** as a manufactured treatment device (MTD) in June 2016. These approvals/certifications issued by TARP member States were granted as a result of the multiple field studies of the **FocalPoint** which were conducted in accordance with the protocol specified by the Washington Department of Ecology's Technology Assessment Protocol – Ecology (TAPE). The first TAPE field study was conducted by Civil and Environmental Consultants, Inc. at a parking lot on Campbell Run Road in Pittsburgh, Pennsylvania during the period of July 2015 to May 2016. Another TAPE field study was conducted by the NAVFAC Engineering and Expeditionary Warfare Center at the Navy Fleet Readiness Center Metal Finishing Complex located on Naval Base Point Loma in San Diego, California during the period of February 2018 to May 2019. A third field study was also conducted in accordance with the North Carolina Department of Environmental Quality and University Field Monitoring Protocols to determine total suspended solids (TSS) and pathogen removal. This study was conducted by North Carolina State University's Department of Biological and Agricultural Engineering on a roadside swale South of US Route 17 in Brunswick County, North Carolina during the period of February 2014 to February 2015.

The **FocalPoint** HPMBS is a structural stormwater treatment system developed by **Convergent Water Technologies**. The system utilizes regionally acceptable vegetation housed in an open-bed style without the use of

a pre-cast concrete container. The system contains energy dissipator stones at the inlet, a mulch layer to capture debris, a layer of engineered soil media, an overflow/bypass outlet, and a modular underdrain system.

This device varies from the design guidance for filtering systems described in Stormwater Rule 250-RICR-150-10-8.23 because of the device's atypically high flow-rate engineered soil media in lieu of traditional filter low flow medias such as: ASTM C33 concrete sand, USDA loamy sand or USDA sandy loam. Additionally, the device in and of itself does not meet minimum requirements for filter bed area or minimum temporary water quality storage. However, the increased infiltration rate compensates for the device's smaller filter bed area and temporary storage. The manufacturer has demonstrated through the provided field studies that the device provides the minimum water quality pollutant removal rates specified in Stormwater Rule 250-RICR-150-10-8.9B. It is approved in Rhode Island for the following pollutant removals when designed with a maximum infiltration rate of 100 inches per hour: **85%** removal of total suspended solids (TSS), **60%** removal of pathogens, **30%** removal of total phosphorus (TP) for discharges to freshwaters, and **30%** removal of total nitrogen (TN) for discharges to tidal waters. This device may be used as an approved water quality BMP provided that the design, installation, and maintenance are conducted in accordance with the following terms and conditions:

I. GENERAL CERTIFICATION REQUIREMENTS

1. The system must be designed and installed to adhere to the manufacturer's specifications titled "SPECIFICATION: HIGH PERFORMANCE MODULAR BIOFILTRATION SYSTEM (HPMBS) Material, Performance and Installation Specification". https://acfenvironmental.com/wp-content/uploads/2015/09/S.1FocalPoint_Specification.pdf

2. The system must be designed to incorporate a PRETX, Rain Guardian or water quality manhole upstream of the filter bed so as to provide a sump to capture and store sediment.
    a. The maximum drainage area that can be directed to each PRETX unit is 1 acre.
    b. The maximum drainage area that can be directed to each upstream water quality manhole is 0.5 acres.
    c. The maximum drainage area that can be directed to each Rain Guardian unit is 0.25 acres.

3. The system must utilize a minimum 3 inch layer of hardwood mulch, a minimum 18 inch layer of the engineered soil media as defined by the device's specification.

4. Systems designed with a modular underdrain must utilize a minimum 6 inch layer of washed 3/8" bridging stone and a high-tenacity monofilament polypropylene yarn, open mesh, woven geotextile to separate the soil media and the underdrain.

5. The system must utilize a plant or plants listed in *Table 2: Approved List of Plants for FocalPoint Systems in Rhode Island***.**

6. The **FocalPoint** HPMBS is **certified as a pretreatment device** in accordance with Stormwater Rule 250-RICR-150-10-8.31, provided the device treats the first inch of runoff from the capture area, unless waived by the state permitting agency.

7. The vendor must provide applicants with a signed letter which verifies that the design for each proprietary device meets the requirements set forth in this certification letter and the device's specification. The applicant must include this verification letter as part of their application.

8. A representative from the vendor must be on site during the installation of systems to ensure that the system is installed in accordance with the manufacturer's specifications and the approved design.

9. The **FocalPoint** HPMBS is **certified as a retrofit device** in accordance with Stormwater Rule 250-RICR-150-10-8.6A. Retrofits are allowed flexibility with regards to the eleven minimum standards described in Sections 8.6 through 8.17 of Stormwater Rule 250-RICR-150-10, but in general they are considered effective if they capture at least 50% of the catchment and meet the target water quality treatment of at least the first 0.5 inches of the water quality volume.

10. This device is **certified as a Water Quality BMP** in accordance with pollutant removal requirements specified in Stormwater Rule 250-RICR-150-10-8.9B, provided that:

    a. The unit is sized to treat the water quality volume and the water quality flow. The filter bed area must be sized to be at least 0.44% of the impervious area that drains into it (this equates to approximately 192 square feet of filter bed area per acre of impervious cover). Pre-detention practices may be utilized as long as the first inch of runoff is treated. Should the permitting agency waive or relieve the applicant from treatment of the full water quality volume (i.e., retrofits or redevelopments), the applicant is granted relief and may design the system to treat a smaller volume, as required by the permitting agency.

    b. This product meets recharge volume requirements, as specified in Stormwater Rule 250-RICR-150-10-8.8, only if designed with a modular underdrain that meets all requirements of a water quality stormwater infiltration practice (excluding standard storage sizing requirements), as specified in Stormwater Rule 250-RICR-150-10-8.21. However, use of **FocalPoint** HPMBS products not designed to infiltrate into in-situ soils are not prohibited so long as the applicant can demonstrate to the permitting agency that the required recharge is met within the sub-watershed, unless waived by the state permitting agency on a case-by-case basis (i.e., LUHHPLs, retrofits or redevelopments).

II. **MAINTENANCE REQUIREMENTS**

1. The device must be maintained in accordance with the manufacturer's specifications provided in the **FocalPoint** HPMBS Operation & Maintenance Manual, which can be found on the manufacturer's website. https://convergewater.wpengine.com/wp-content/uploads/2021/06/focalpoint-operations-maintenance-guide.pdf

2. The entire device (mulch, soil media, underdrain, etc.) must be maintained in accordance with the requirements for filtering system water quality BMPs, as stated in Stormwater Rule 250-RICR-150-10-8.23-F.3 which requires that the entire device must be inspected on at least an annual basis and after storms equal to or greater than the 1-year Type-III 24-hour design storm.

3. The device must be maintained in accordance with Stormwater Rule 250-RICR-150-10-8.23-F.1b which requires that "silt/sediment shall be removed from the filter bed when the accumulation exceeds one inch. When the filtering capacity of the device diminishes substantially (water ponds on the surface of the filter bed for more than 48 hours), the top few inches of discolored material shall be removed and shall be replaced with fresh material" (where "fresh material" means the engineered soil media described in the manufacturer's specification). If it is determined that replacing the top few inches of discolored material (or other restoration methods) does not restore the device's filtering capacity (water is still ponding on the filter bed for more than 48 hours), then the entirety of the device's filtering media must be replaced with fresh material.

4. The device's sump (i.e., PRETX, Rain Guardian, or upstream manhole) must be maintained in accordance with the requirements for proprietary pre-treatment devices, as stated in Stormwater Rule 250-RICR-150-10-8.31-C, which requires the sump to be inspected a minimum of 2 times per year. Additionally, the sump must be cleaned out when 50% or more of the pollutant storage capacity is filled or displaced.

5. All material removed from the unit must be properly disposed of and is the responsibility of the owner.

6. The applicant must provide evidence of a maintenance contract which extends for a minimum of two years. The contracted maintenance provider must receive training by **Convergent Water Technologies** on how to properly maintain **FocalPoint** HPMBS devices. This requirement excludes maintenance providers recognized by the RIDEM to be qualified in the maintenance of **FocalPoint** HPMBS devices.

7. The applicant must include a copy of the **FocalPoint** HPMBS Operation & Maintenance Manual in their project specific long term operation and maintenance plan.

III.**REPORTING REQUIREMENTS**

1. Upon request from the owner of any **FocalPoint** HPMBS system installed in the State of Rhode Island, the vendor shall provide the owner with a recommended maintenance schedule after the first year of operation. If a recommended maintenance schedule is requested by the owner after the first year of the device's operation, then the owner is responsible for notifying the vendor of any additional pollutant loads on sites where contributing drainage areas may be subject to further development (i.e., strip malls).

2. The Vendor shall provide a listing to the RIDEM Office of Water Resources of all systems installed within the State of Rhode Island on an annual basis. This list shall also include the name of the Vendor representative who was on-site to verify proper installation of each system.

3. The Vendor shall provide an annual listing to the RIDEM Office of Water Resources of all Rhode Island maintenance providers that they trained in **FocalPoint** HPMBS maintenance.

4. The Vendor shall immediately notify the RIDEM Office of Water Resources if and when any changes are made to the model name or number of any **FocalPoint** HPMBS device applicable to this certification.

5. The Vendor shall immediately notify the RIDEM Office of Water Resources if and when any revisions are made to the design, installation or operation and maintenance manuals for all models applicable to this certification.

6. The Vendor shall notify the RIDEM within at least thirty (30) days following any proposed transfer of ownership of the Component technology. Notification shall include the name and address of the new owner and a written agreement between the existing and new owner specifying a date for transfer of ownership, responsibility, and liability for the Component. All provisions of this Certification shall be applicable to any new owners.

IV. **RIGHTS OF THE RIDEM AND CRMC**

1. The RIDEM may suspend, modify or revoke this approval for cause, including but not limited to non-compliance with any of the conditions or provisions of this approval, mis-representation or failure to fully disclose all relevant data, or receipt of new information indicating that the use of the **FocalPoint** HPMBS system is contrary to the public interest, public health or the environment.

2. This approval does not represent an endorsement of the **FocalPoint** HPMBS system by the RIDEM, RIDOT or CRMC. This letter of approval may be reproduced only in its entirety.

3. The **FocalPoint** HPMBS Bioretention System Standard Specification and **FocalPoint** HPMBS operation and maintenance manual referenced herein are approved upon the date of approval of this Certification.

4. The RIDEM reserves the right to suspend or revoke this Certification if updated design, installation, and O&M manuals are not provided to the RIDEM within thirty (30) days of RIDEM request or one hundred and eighty (180) days prior to the expiration date of this Certification. All revisions must be reviewed and approved by the RIDEM prior to re-certification.

Eric A. Beck, P.E. Date
Administrator of Groundwater and Wetlands Protection
RIDEM – Office of Water Resources

ATTACHMENTS:

Table 2: Approved List of Plants for FocalPoint Systems in Rhode Island

Common Name/Species	*Spacing*	*Exposure*	*Comments*
American Beach Grass/ Ammophila breviligulata	*24" on center*	*Full and high high temperatures*	*Tolerates wet to well-drained soil; flowers appear to float; high wildlife value.*
Switchgrass/Pancium virgatum	*24" on center*	*Full sun, high temperatures*	*Tolerates wet to well-drained soil; flowers appear to float; high wildlife value.*
Day Lily/ Hemerocallis	*24" on center*	*Full sun, tolerate shade*	*Yellow, Red and Pink colors available. Many red and purple varieties benefit from partial shade in the hottest part of the day since dark colors absorb heat and do not withstand the sun as well as lighter colors.*
Black Eyed Susan/Rudbeckia hirta	*24" on center*	*Full sun, tolerate shade*	*Widely cultivated in parks and gardens, for summer bedding schemes, borders, containers, wildflower gardens, prairie-style plantings and cut flowers.*
Cone Flower/Echinacea	*24" on center*	*Full sun, tolerate shade*	*Herbaceous flowering plant in the daisy family. Grows in moist to dry prairies and open wooded areas.*

A3.4.2 Drainage Network Hydraulic Calculations

DiPrete Engineering
Engineers • Planners • Surveyors

Project Name: Seasons Corner Market
Project Number: 2015-001

25-Year Storm
Date: 6/27/2022

Pipe Analysis

Pipe ID	Pipe Length	Pipe Size	Pipe Slope	Flow Rate	Capacity Full	Velocity	Invert Down	Invert Up
	(ft)	(in)	(%)	(cfs)	(cfs)	(ft/s)	(Ft)	(ft)
2	97.03	12	0.50%	1.6	2.74	3.6	292.40	292.89
22	60.23	12	0.50%	2.1	2.73	3.8	292.40	292.71
7	76.44	12	0.50%	1.5	2.73	3.5	292.71	293.09
9	6.92	12	0.99%	0.7	3.84	3.7	292.71	292.77
70	18.03	9.996	1.00%	1.0	2.38	4.1	292.40	292.58

DiPrete Engineering
Engineers • Planners • Surveyors

Project Name: Seasons Corner Market
Project Number: 2015-001

100-Year Storm
Date: 6/27/2022

Pipe Analysis

Pipe ID	Pipe Length	Pipe Size	Pipe Slope	Flow Rate	Capacity Full	Velocity	Invert Down	Invert Up
	(ft)	(in)	(%)	(cfs)	(cfs)	(ft/s)	(Ft)	(ft)
2	97.03	12	0.50%	2.0	2.74	3.8	292.40	292.89
22	60.23	12	0.50%	2.7	2.73	4.0	292.40	292.71
7	76.44	12	0.50%	1.9	2.73	3.7	292.71	293.09
9	6.92	12	0.99%	0.9	3.84	4.0	292.71	292.77
70	18.03	9.996	1.00%	1.2	2.38	4.4	292.40	292.58

DiPrete Engineering
Engineers • Planners • Surveyors

Project Name: Seasons Corner Market — 100-Year Storm
Project Number: 2015-001 — Date: 6/27/2022

HGL at Structure

Structure	Rim Elevation (ft)	HGL Elevation (ft)	Rim-HGL (ft)
6	296.36	0.00	N/A
2	295.05	294.01	1.04
11	295.64	294.05	1.59
10	295.60	294.46	1.14
13	295.34	294.32	1.02
RL	296.53	293.80	2.73

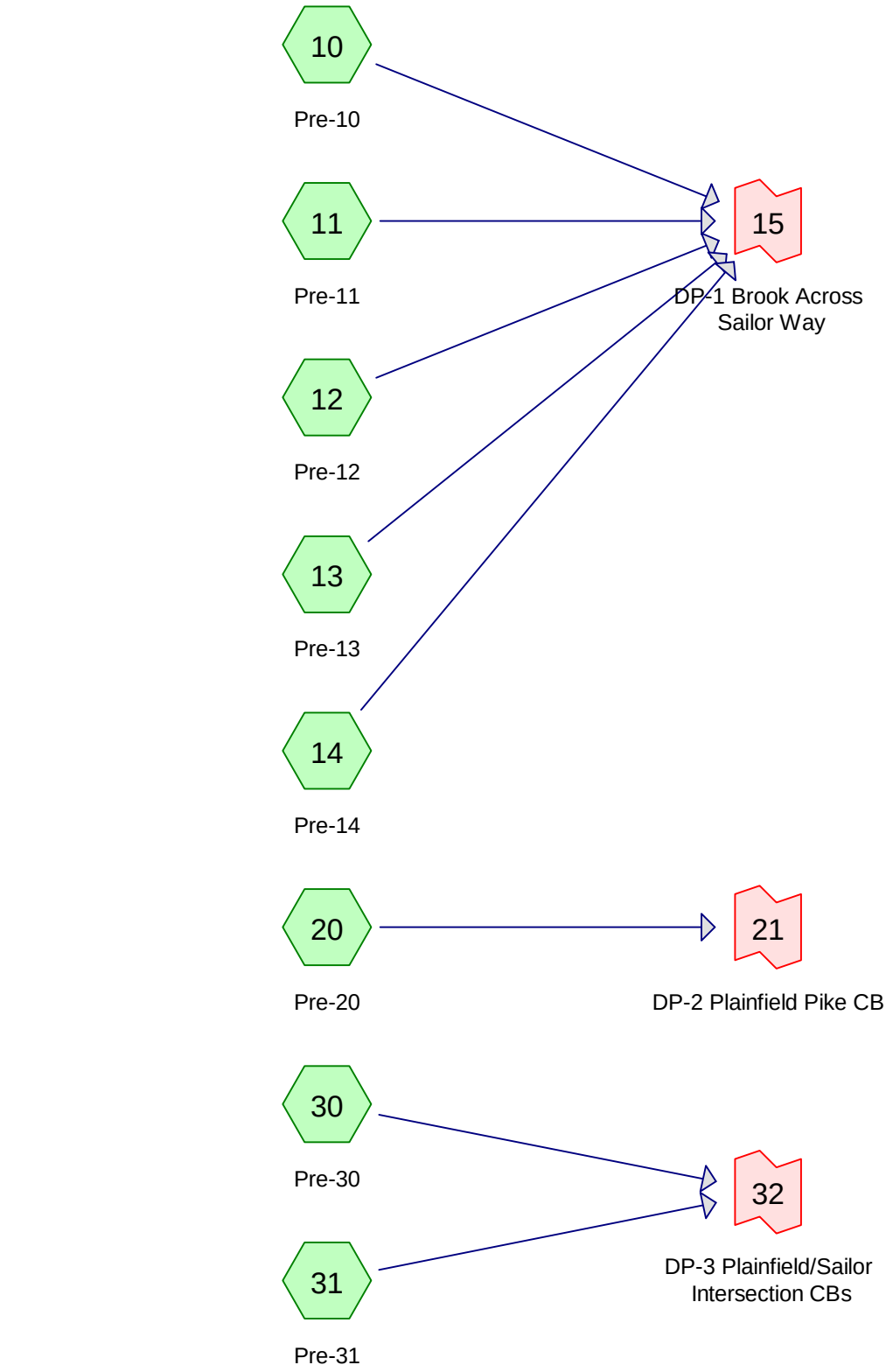
DiPrete Engineering
Engineers • Planners • Surveyors

Project Name: Seasons Corner Market
Project Number: 2015-001

10-Year Storm
Date: 6/27/2022

Structure	Area	Inlet Time	Intensity	Runoff C	Q=Cia	Q Carry over	Q Captured	Q Bypassed	Bypass Structure	Inlet Type	Curb Opening	Curb Opening	Grate Length	Grate Width	Depth	Spread
	(sf)	(min)	(in/hr)	(C)	(cfs)	(cfs)	(cfs)	(cfs)			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
10	8,243	6	6.94	0.9	1.19	0	1.19	0.00	---	Grate inlet	---	---	2	2	0.184	9.182
13	3,937	6	6.938	0.9	0.57	0	0.57	0.00	---	Grate inlet	---	---	2	2	0.12	5.999

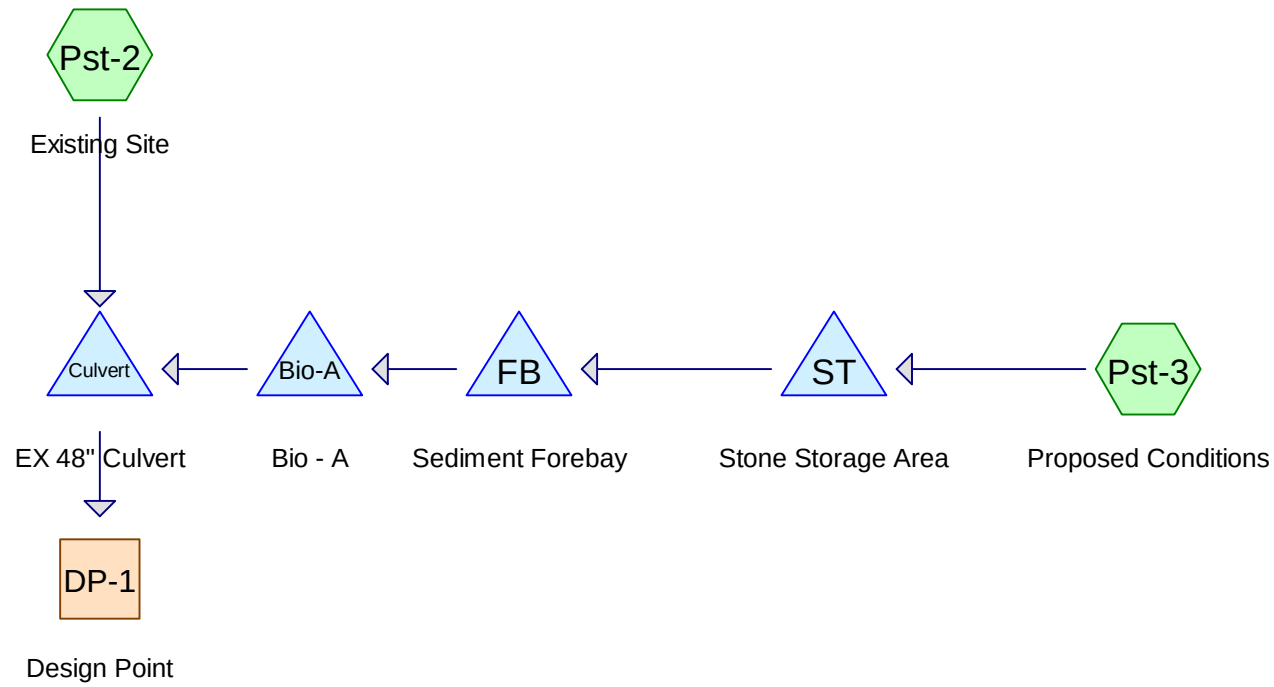
A3.5.4.1 HydroCAD Node Diagram

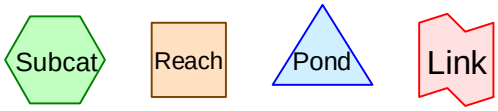


Routing Diagram for 2015-001-EHCD
Prepared by DiPrete Engineering, Printed 6/27/2022
HydroCAD® 10.10-4b s/n 01125 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.000	0	, HSG B (31)
0.225	61	>75% Grass cover, Good, HSG B (13, 20, 30, 31)
0.324	80	>75% Grass cover, Good, HSG D (13, 14, 20, 30, 31)
0.011	96	Gravel surface, HSG B (20)
0.032	96	Gravel surface, HSG D (20)
0.355	98	Impervious, HSG B (10, 11, 12, 13, 20, 30, 31)
0.269	98	Impervious, HSG D (10, 12, 14, 20, 30, 31)
0.045	98	Offsite Impervious, HSG B (13, 20, 31)
0.028	98	Offsite Impervious, HSG D (13, 14, 20, 30, 31)
0.072	98	Roofs, HSG B (12, 31)
0.096	98	Roofs, HSG D (12)
0.145	77	Woods, Good, HSG D (13)
1.600	**87**	**TOTAL AREA**

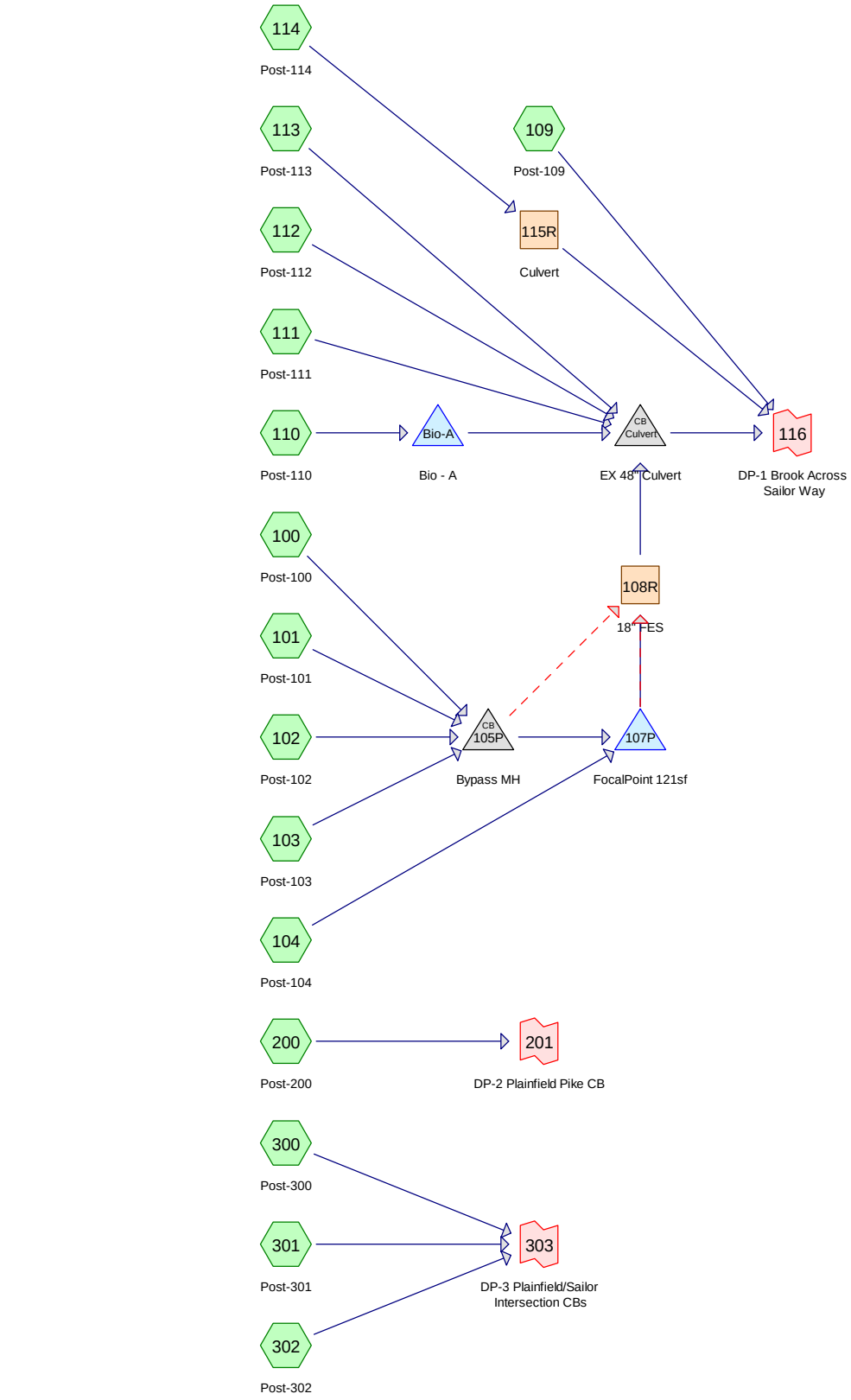




Routing Diagram for 1215-001-ALLS-PHCD-INHS-20121101
Prepared by DiPrete Engineering, Printed 6/27/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.009	74	Existing Grassed Area (Pst-2)
0.358	98	Existing Pavement (Pst-2, Pst-3)
0.108	98	Existing Roof (Pst-2, Pst-3)
0.046	74	Sediment FB/Bioretention Area (Pst-3)
0.081	98	Stone Storage Area (Pst-3)
0.602	**96**	**TOTAL AREA**



Routing Diagram for 2015-001-PHCD
Prepared by DiPrete Engineering, Printed 6/27/2022
HydroCAD® 10.10-4b s/n 01125 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.000	0	, HSG B (109)
0.454	61	>75% Grass cover, Good, HSG B (103, 104, 110, 111, 112, 200, 300, 301, 302)
0.482	80	>75% Grass cover, Good, HSG D (101, 103, 110, 111, 112, 114, 200, 300, 301)
0.011	96	Gravel surface, HSG B (200)
0.052	96	Gravel surface, HSG D (103, 200)
0.408	98	Impervious, HSG B (101, 103, 104, 109, 110, 113, 200, 301, 302)
0.392	98	Impervious, HSG D (101, 103, 110, 113, 114, 200, 301)
0.053	98	Offsite Impervious, HSG B (109, 112, 200, 301)
0.018	98	Offsite Impervious, HSG D (112, 200, 300, 301)
0.100	98	Roofs, HSG B (100, 101, 102, 110, 200)
0.111	98	Roofs, HSG D (100, 102)
0.000	55	Woods, Good, HSG B (112)
0.147	77	Woods, Good, HSG D (111, 112)
2.228	**85**	**TOTAL AREA**

A3.5.4.2 HydroCAD 1-Year Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: Pre-10 Runoff Area=0.022 ac 100.00% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=98 Runoff=0.06 cfs 0.005 af

Subcatchment 11: Pre-11 Runoff Area=0.019 ac 100.00% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=98 Runoff=0.05 cfs 0.004 af

Subcatchment 12: Pre-12 Runoff Area=0.168 ac 100.00% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=98 Runoff=0.44 cfs 0.035 af

Subcatchment 13: Pre-13 Runoff Area=0.162 ac 0.36% Impervious Runoff Depth=0.77"
Tc=6.0 min CN=75 Runoff=0.13 cfs 0.010 af

Subcatchment 14: Pre-14 Runoff Area=0.088 ac 67.03% Impervious Runoff Depth=1.88"
Tc=6.0 min CN=92 Runoff=0.19 cfs 0.014 af

Subcatchment 20: Pre-20 Runoff Area=0.405 ac 66.06% Impervious Runoff Depth=1.79"
Tc=6.0 min CN=91 Runoff=0.84 cfs 0.061 af

Subcatchment 30: Pre-30 Runoff Area=0.414 ac 22.28% Impervious Runoff Depth=0.97"
Tc=6.0 min CN=79 Runoff=0.46 cfs 0.034 af

Subcatchment 31: Pre-31 Runoff Area=0.323 ac 73.15% Impervious Runoff Depth=1.79"
Tc=6.0 min CN=91 Runoff=0.67 cfs 0.048 af

Link 15: DP-1 Brook Across Sailor Way Inflow=0.87 cfs 0.067 af
Primary=0.87 cfs 0.067 af

Link 21: DP-2 Plainfield Pike CB Inflow=0.84 cfs 0.061 af
Primary=0.84 cfs 0.061 af

Link 32: DP-3 Plainfield/Sailor Intersection CBs Inflow=1.13 cfs 0.082 af
Primary=1.13 cfs 0.082 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Pst-2: Existing Site Runoff Area=0.224 ac 95.98% Impervious Runoff Depth=2.36"
Tc=6.0 min CN=97 Runoff=0.57 cfs 0.044 af

Subcatchment Pst-3: Proposed Conditions Runoff Area=0.378 ac 87.83% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=95 Runoff=0.91 cfs 0.068 af

Reach DP-1: Design Point Inflow=0.61 cfs 0.107 af
Outflow=0.61 cfs 0.107 af

Pond Bio-A: Bio - A Peak Elev=292.54' Storage=539 cf Inflow=0.31 cfs 0.063 af
Outflow=0.31 cfs 0.063 af

Pond Culvert: EX 48" Culvert Peak Elev=284.92' Storage=0.000 af Inflow=0.61 cfs 0.107 af
48.0" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=0.61 cfs 0.107 af

Pond FB: Sediment Forebay Peak Elev=292.57' Storage=217 cf Inflow=0.31 cfs 0.068 af
Outflow=0.31 cfs 0.063 af

Pond ST: Stone Storage Area Peak Elev=291.87' Storage=839 cf Inflow=0.91 cfs 0.068 af
Outflow=0.31 cfs 0.068 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100: Post-100 Runoff Area=0.078 ac 100.00% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=98 Runoff=0.20 cfs 0.016 af

Subcatchment 101: Post-101 Runoff Area=0.123 ac 99.09% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=98 Runoff=0.32 cfs 0.025 af

Subcatchment 102: Post-102 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=98 Runoff=0.32 cfs 0.025 af

Subcatchment 103: Post-103 Runoff Area=0.280 ac 68.27% Impervious Runoff Depth=2.06"
Tc=6.0 min CN=94 Runoff=0.65 cfs 0.048 af

Subcatchment 104: Post-104 Runoff Area=0.037 ac 1.00% Impervious Runoff Depth=0.26"
Tc=6.0 min CN=61 Runoff=0.00 cfs 0.001 af

Subcatchment 109: Post-109 Runoff Area=0.037 ac 100.00% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=98 Runoff=0.10 cfs 0.008 af

Subcatchment 110: Post-110 Runoff Area=0.124 ac 91.05% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=95 Runoff=0.30 cfs 0.022 af

Subcatchment 111: Post-111 Runoff Area=0.156 ac 0.00% Impervious Runoff Depth=0.64"
Tc=6.0 min CN=72 Runoff=0.10 cfs 0.008 af

Subcatchment 112: Post-112 Runoff Area=0.157 ac 0.29% Impervious Runoff Depth=0.82"
Tc=6.0 min CN=76 Runoff=0.14 cfs 0.011 af

Subcatchment 113: Post-113 Runoff Area=0.055 ac 100.00% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=98 Runoff=0.14 cfs 0.011 af

Subcatchment 114: Post-114 Runoff Area=0.114 ac 55.50% Impervious Runoff Depth=1.71"
Tc=6.0 min CN=90 Runoff=0.23 cfs 0.016 af

Subcatchment 200: Post-200 Runoff Area=0.233 ac 55.05% Impervious Runoff Depth=1.48"
Tc=6.0 min CN=87 Runoff=0.40 cfs 0.029 af

Subcatchment 300: Post-300 Runoff Area=0.326 ac 0.70% Impervious Runoff Depth=0.72"
Tc=6.0 min CN=74 Runoff=0.25 cfs 0.020 af

Subcatchment 301: Post-301 Runoff Area=0.307 ac 31.52% Impervious Runoff Depth=0.87"
Tc=6.0 min CN=77 Runoff=0.30 cfs 0.022 af

Subcatchment 302: Post-302 Runoff Area=0.078 ac 91.26% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=95 Runoff=0.19 cfs 0.014 af

Reach 108R: 18" FES Inflow=1.49 cfs 0.116 af
Outflow=1.49 cfs 0.116 af

Reach 115R: Culvert Avg. Flow Depth=0.16' Max Vel=2.86 fps Inflow=0.23 cfs 0.016 af
12.00" Round Pipe n=0.011 L=72.0' S=0.0100 '/' Capacity=4.21 cfs Outflow=0.23 cfs 0.016 af

Pond 105P: Bypass MH Peak Elev=293.48' Inflow=1.50 cfs 0.115 af
Primary=0.57 cfs 0.100 af Secondary=0.93 cfs 0.015 af Outflow=1.50 cfs 0.115 af

Pond 107P: FocalPoint 121sf Peak Elev=292.84' Storage=234 cf Inflow=0.57 cfs 0.101 af
Outflow=0.57 cfs 0.101 af

Pond Bio-A: Bio - A Peak Elev=292.15' Storage=345 cf Inflow=0.30 cfs 0.022 af
Outflow=0.04 cfs 0.022 af

Pond Culvert: EX 48" Culvert Peak Elev=285.13' Inflow=1.91 cfs 0.168 af
48.00" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=1.91 cfs 0.168 af

Link 116: DP-1 Brook Across Sailor Way Inflow=2.24 cfs 0.192 af
Primary=2.24 cfs 0.192 af

Link 201: DP-2 Plainfield Pike CB Inflow=0.40 cfs 0.029 af
Primary=0.40 cfs 0.029 af

Link 303: DP-3 Plainfield/Sailor Intersection CBs Inflow=0.73 cfs 0.056 af
Primary=0.73 cfs 0.056 af

A3.5.4.3 HydroCAD 2-Year Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: Pre-10 Runoff Area=0.022 ac 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=98 Runoff=0.07 cfs 0.006 af

Subcatchment 11: Pre-11 Runoff Area=0.019 ac 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=98 Runoff=0.06 cfs 0.005 af

Subcatchment 12: Pre-12 Runoff Area=0.168 ac 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=98 Runoff=0.54 cfs 0.043 af

Subcatchment 13: Pre-13 Runoff Area=0.162 ac 0.36% Impervious Runoff Depth=1.16"
Tc=6.0 min CN=75 Runoff=0.21 cfs 0.016 af

Subcatchment 14: Pre-14 Runoff Area=0.088 ac 67.03% Impervious Runoff Depth=2.45"
Tc=6.0 min CN=92 Runoff=0.25 cfs 0.018 af

Subcatchment 20: Pre-20 Runoff Area=0.405 ac 66.06% Impervious Runoff Depth=2.35"
Tc=6.0 min CN=91 Runoff=1.10 cfs 0.079 af

Subcatchment 30: Pre-30 Runoff Area=0.414 ac 22.28% Impervious Runoff Depth=1.41"
Tc=6.0 min CN=79 Runoff=0.68 cfs 0.049 af

Subcatchment 31: Pre-31 Runoff Area=0.323 ac 73.15% Impervious Runoff Depth=2.35"
Tc=6.0 min CN=91 Runoff=0.87 cfs 0.063 af

Link 15: DP-1 Brook Across Sailor Way Inflow=1.13 cfs 0.087 af
Primary=1.13 cfs 0.087 af

Link 21: DP-2 Plainfield Pike CB Inflow=1.10 cfs 0.079 af
Primary=1.10 cfs 0.079 af

Link 32: DP-3 Plainfield/Sailor Intersection CBs Inflow=1.55 cfs 0.112 af
Primary=1.55 cfs 0.112 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Pst-2: Existing Site Runoff Area=0.224 ac 95.98% Impervious Runoff Depth=2.96"
Tc=6.0 min CN=97 Runoff=0.71 cfs 0.055 af

Subcatchment Pst-3: Proposed Conditions Runoff Area=0.378 ac 87.83% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=95 Runoff=1.15 cfs 0.086 af

Reach DP-1: Design Point Inflow=0.75 cfs 0.137 af
Outflow=0.75 cfs 0.137 af

Pond Bio-A: Bio - A Peak Elev=292.54' Storage=542 cf Inflow=0.37 cfs 0.082 af
Outflow=0.37 cfs 0.082 af

Pond Culvert: EX 48" Culvert Peak Elev=284.95' Storage=0.000 af Inflow=0.75 cfs 0.137 af
48.0" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=0.75 cfs 0.137 af

Pond FB: Sediment Forebay Peak Elev=292.58' Storage=218 cf Inflow=0.37 cfs 0.086 af
Outflow=0.37 cfs 0.082 af

Pond ST: Stone Storage Area Peak Elev=292.08' Storage=1,074 cf Inflow=1.15 cfs 0.086 af
Outflow=0.37 cfs 0.086 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100: Post-100 Runoff Area=0.078 ac 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=98 Runoff=0.25 cfs 0.020 af

Subcatchment 101: Post-101 Runoff Area=0.123 ac 99.09% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=98 Runoff=0.40 cfs 0.032 af

Subcatchment 102: Post-102 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=98 Runoff=0.40 cfs 0.032 af

Subcatchment 103: Post-103 Runoff Area=0.280 ac 68.27% Impervious Runoff Depth=2.64"
Tc=6.0 min CN=94 Runoff=0.83 cfs 0.062 af

Subcatchment 104: Post-104 Runoff Area=0.037 ac 1.00% Impervious Runoff Depth=0.49"
Tc=6.0 min CN=61 Runoff=0.01 cfs 0.001 af

Subcatchment 109: Post-109 Runoff Area=0.037 ac 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=98 Runoff=0.12 cfs 0.010 af

Subcatchment 110: Post-110 Runoff Area=0.124 ac 91.05% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=95 Runoff=0.37 cfs 0.028 af

Subcatchment 111: Post-111 Runoff Area=0.156 ac 0.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=72 Runoff=0.17 cfs 0.013 af

Subcatchment 112: Post-112 Runoff Area=0.157 ac 0.29% Impervious Runoff Depth=1.22"
Tc=6.0 min CN=76 Runoff=0.22 cfs 0.016 af

Subcatchment 113: Post-113 Runoff Area=0.055 ac 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=98 Runoff=0.18 cfs 0.014 af

Subcatchment 114: Post-114 Runoff Area=0.114 ac 55.50% Impervious Runoff Depth=2.26"
Tc=6.0 min CN=90 Runoff=0.30 cfs 0.021 af

Subcatchment 200: Post-200 Runoff Area=0.233 ac 55.05% Impervious Runoff Depth=2.00"
Tc=6.0 min CN=87 Runoff=0.55 cfs 0.039 af

Subcatchment 300: Post-300 Runoff Area=0.326 ac 0.70% Impervious Runoff Depth=1.10"
Tc=6.0 min CN=74 Runoff=0.40 cfs 0.030 af

Subcatchment 301: Post-301 Runoff Area=0.307 ac 31.52% Impervious Runoff Depth=1.28"
Tc=6.0 min CN=77 Runoff=0.45 cfs 0.033 af

Subcatchment 302: Post-302 Runoff Area=0.078 ac 91.26% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=95 Runoff=0.24 cfs 0.018 af

Reach 108R: 18" FES Inflow=1.88 cfs 0.146 af
Outflow=1.88 cfs 0.146 af

Reach 115R: Culvert Avg. Flow Depth=0.18' Max Vel=3.10 fps Inflow=0.30 cfs 0.021 af
12.00" Round Pipe n=0.011 L=72.0' S=0.0100 '/' Capacity=4.21 cfs Outflow=0.30 cfs 0.021 af

Pond 105P: Bypass MH Peak Elev=293.51' Inflow=1.87 cfs 0.145 af
Primary=0.58 cfs 0.121 af Secondary=1.28 cfs 0.024 af Outflow=1.87 cfs 0.145 af

Pond 107P: FocalPoint 121sf Peak Elev=292.85' Storage=236 cf Inflow=0.60 cfs 0.122 af
Outflow=0.60 cfs 0.122 af

Pond Bio-A: Bio - A Peak Elev=292.40' Storage=468 cf Inflow=0.37 cfs 0.028 af
Outflow=0.05 cfs 0.028 af

Pond Culvert: EX 48" Culvert Peak Elev=285.19' Inflow=2.48 cfs 0.217 af
48.00" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=2.48 cfs 0.217 af

Link 116: DP-1 Brook Across Sailor Way Inflow=2.89 cfs 0.248 af
Primary=2.89 cfs 0.248 af

Link 201: DP-2 Plainfield Pike CB Inflow=0.55 cfs 0.039 af
Primary=0.55 cfs 0.039 af

Link 303: DP-3 Plainfield/Sailor Intersection CBs Inflow=1.09 cfs 0.081 af
Primary=1.09 cfs 0.081 af

A3.5.4.4 HydroCAD 10-Year Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: Pre-10 Runoff Area=0.022 ac 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.11 cfs 0.009 af

Subcatchment 11: Pre-11 Runoff Area=0.019 ac 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.09 cfs 0.007 af

Subcatchment 12: Pre-12 Runoff Area=0.168 ac 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.80 cfs 0.065 af

Subcatchment 13: Pre-13 Runoff Area=0.162 ac 0.36% Impervious Runoff Depth=2.37"
Tc=6.0 min CN=75 Runoff=0.45 cfs 0.032 af

Subcatchment 14: Pre-14 Runoff Area=0.088 ac 67.03% Impervious Runoff Depth=3.99"
Tc=6.0 min CN=92 Runoff=0.39 cfs 0.029 af

Subcatchment 20: Pre-20 Runoff Area=0.405 ac 66.06% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=91 Runoff=1.77 cfs 0.131 af

Subcatchment 30: Pre-30 Runoff Area=0.414 ac 22.28% Impervious Runoff Depth=2.72"
Tc=6.0 min CN=79 Runoff=1.32 cfs 0.094 af

Subcatchment 31: Pre-31 Runoff Area=0.323 ac 73.15% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=91 Runoff=1.41 cfs 0.104 af

Link 15: DP-1 Brook Across Sailor Way Inflow=1.84 cfs 0.142 af
Primary=1.84 cfs 0.142 af

Link 21: DP-2 Plainfield Pike CB Inflow=1.77 cfs 0.131 af
Primary=1.77 cfs 0.131 af

Link 32: DP-3 Plainfield/Sailor Intersection CBs Inflow=2.73 cfs 0.198 af
Primary=2.73 cfs 0.198 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Pst-2: Existing Site Runoff Area=0.224 ac 95.98% Impervious Runoff Depth=4.55"
Tc=6.0 min CN=97 Runoff=1.07 cfs 0.085 af

Subcatchment Pst-3: Proposed Conditions Runoff Area=0.378 ac 87.83% Impervious Runoff Depth=4.32"
Tc=6.0 min CN=95 Runoff=1.76 cfs 0.136 af

Reach DP-1: Design Point Inflow=1.51 cfs 0.216 af
Outflow=1.51 cfs 0.216 af

Pond Bio-A: Bio - A Peak Elev=292.59' Storage=568 cf Inflow=0.99 cfs 0.131 af
Outflow=0.96 cfs 0.131 af

Pond Culvert: EX 48" Culvert Peak Elev=285.07' Storage=0.000 af Inflow=1.51 cfs 0.216 af
48.0" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=1.51 cfs 0.216 af

Pond FB: Sediment Forebay Peak Elev=292.65' Storage=229 cf Inflow=1.00 cfs 0.136 af
Outflow=0.99 cfs 0.131 af

Pond ST: Stone Storage Area Peak Elev=292.46' Storage=1,520 cf Inflow=1.76 cfs 0.136 af
Outflow=1.00 cfs 0.136 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100: Post-100 Runoff Area=0.078 ac 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af

Subcatchment 101: Post-101 Runoff Area=0.123 ac 99.09% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.59 cfs 0.048 af

Subcatchment 102: Post-102 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.59 cfs 0.048 af

Subcatchment 103: Post-103 Runoff Area=0.280 ac 68.27% Impervious Runoff Depth=4.21"
Tc=6.0 min CN=94 Runoff=1.28 cfs 0.098 af

Subcatchment 104: Post-104 Runoff Area=0.037 ac 1.00% Impervious Runoff Depth=1.31"
Tc=6.0 min CN=61 Runoff=0.05 cfs 0.004 af

Subcatchment 109: Post-109 Runoff Area=0.037 ac 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.18 cfs 0.015 af

Subcatchment 110: Post-110 Runoff Area=0.124 ac 91.05% Impervious Runoff Depth=4.32"
Tc=6.0 min CN=95 Runoff=0.58 cfs 0.044 af

Subcatchment 111: Post-111 Runoff Area=0.156 ac 0.00% Impervious Runoff Depth=2.12"
Tc=6.0 min CN=72 Runoff=0.38 cfs 0.028 af

Subcatchment 112: Post-112 Runoff Area=0.157 ac 0.29% Impervious Runoff Depth=2.45"
Tc=6.0 min CN=76 Runoff=0.45 cfs 0.032 af

Subcatchment 113: Post-113 Runoff Area=0.055 ac 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.26 cfs 0.021 af

Subcatchment 114: Post-114 Runoff Area=0.114 ac 55.50% Impervious Runoff Depth=3.78"
Tc=6.0 min CN=90 Runoff=0.49 cfs 0.036 af

Subcatchment 200: Post-200 Runoff Area=0.233 ac 55.05% Impervious Runoff Depth=3.47"
Tc=6.0 min CN=87 Runoff=0.93 cfs 0.067 af

Subcatchment 300: Post-300 Runoff Area=0.326 ac 0.70% Impervious Runoff Depth=2.28"
Tc=6.0 min CN=74 Runoff=0.87 cfs 0.062 af

Subcatchment 301: Post-301 Runoff Area=0.307 ac 31.52% Impervious Runoff Depth=2.54"
Tc=6.0 min CN=77 Runoff=0.92 cfs 0.065 af

Subcatchment 302: Post-302 Runoff Area=0.078 ac 91.26% Impervious Runoff Depth=4.32"
Tc=6.0 min CN=95 Runoff=0.37 cfs 0.028 af

Reach 108R: 18" FES Inflow=2.88 cfs 0.228 af
Outflow=2.88 cfs 0.228 af

Reach 115R: Culvert Avg. Flow Depth=0.23' Max Vel=3.58 fps Inflow=0.49 cfs 0.036 af
12.00" Round Pipe n=0.011 L=72.0' S=0.0100 '/' Capacity=4.21 cfs Outflow=0.49 cfs 0.036 af

Pond 105P: Bypass MH Peak Elev=293.60' Inflow=2.84 cfs 0.224 af
Primary=0.62 cfs 0.172 af Secondary=2.22 cfs 0.052 af Outflow=2.84 cfs 0.224 af

Pond 107P: FocalPoint 121sf Peak Elev=292.86' Storage=240 cf Inflow=0.67 cfs 0.176 af
Outflow=0.67 cfs 0.176 af

Pond Bio-A: Bio - A Peak Elev=292.55' Storage=547 cf Inflow=0.58 cfs 0.044 af
Outflow=0.44 cfs 0.044 af

Pond Culvert: EX 48" Culvert Peak Elev=285.34' Inflow=4.03 cfs 0.354 af
48.00" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=4.03 cfs 0.354 af

Link 116: DP-1 Brook Across Sailor Way Inflow=4.69 cfs 0.404 af
Primary=4.69 cfs 0.404 af

Link 201: DP-2 Plainfield Pike CB Inflow=0.93 cfs 0.067 af
Primary=0.93 cfs 0.067 af

Link 303: DP-3 Plainfield/Sailor Intersection CBs Inflow=2.15 cfs 0.155 af
Primary=2.15 cfs 0.155 af

A3.5.4.5 HydroCAD 25-Year Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: Pre-10 Runoff Area=0.022 ac 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=98 Runoff=0.13 cfs 0.011 af

Subcatchment 11: Pre-11 Runoff Area=0.019 ac 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=98 Runoff=0.11 cfs 0.009 af

Subcatchment 12: Pre-12 Runoff Area=0.168 ac 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=98 Runoff=1.00 cfs 0.082 af

Subcatchment 13: Pre-13 Runoff Area=0.162 ac 0.36% Impervious Runoff Depth=3.37"
Tc=6.0 min CN=75 Runoff=0.64 cfs 0.045 af

Subcatchment 14: Pre-14 Runoff Area=0.088 ac 67.03% Impervious Runoff Depth=5.17"
Tc=6.0 min CN=92 Runoff=0.50 cfs 0.038 af

Subcatchment 20: Pre-20 Runoff Area=0.405 ac 66.06% Impervious Runoff Depth=5.06"
Tc=6.0 min CN=91 Runoff=2.27 cfs 0.171 af

Subcatchment 30: Pre-30 Runoff Area=0.414 ac 22.28% Impervious Runoff Depth=3.77"
Tc=6.0 min CN=79 Runoff=1.82 cfs 0.130 af

Subcatchment 31: Pre-31 Runoff Area=0.323 ac 73.15% Impervious Runoff Depth=5.06"
Tc=6.0 min CN=91 Runoff=1.81 cfs 0.136 af

Link 15: DP-1 Brook Across Sailor Way Inflow=2.38 cfs 0.185 af
Primary=2.38 cfs 0.185 af

Link 21: DP-2 Plainfield Pike CB Inflow=2.27 cfs 0.171 af
Primary=2.27 cfs 0.171 af

Link 32: DP-3 Plainfield/Sailor Intersection CBs Inflow=3.63 cfs 0.266 af
Primary=3.63 cfs 0.266 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Pst-2: Existing Site Runoff Area=0.224 ac 95.98% Impervious Runoff Depth=5.74"
Tc=6.0 min CN=97 Runoff=1.33 cfs 0.107 af

Subcatchment Pst-3: Proposed Conditions Runoff Area=0.378 ac 87.83% Impervious Runoff Depth=5.51"
Tc=6.0 min CN=95 Runoff=2.22 cfs 0.174 af

Reach DP-1: Design Point Inflow=3.10 cfs 0.276 af
Outflow=3.10 cfs 0.276 af

Pond Bio-A: Bio - A Peak Elev=292.65' Storage=602 cf Inflow=2.04 cfs 0.169 af
Outflow=1.96 cfs 0.169 af

Pond Culvert: EX 48" Culvert Peak Elev=285.26' Storage=0.000 af Inflow=3.10 cfs 0.276 af
48.0" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=3.10 cfs 0.276 af

Pond FB: Sediment Forebay Peak Elev=292.73' Storage=243 cf Inflow=2.04 cfs 0.174 af
Outflow=2.04 cfs 0.169 af

Pond ST: Stone Storage Area Peak Elev=292.49' Storage=1,558 cf Inflow=2.22 cfs 0.174 af
Outflow=2.04 cfs 0.174 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100: Post-100 Runoff Area=0.078 ac 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af

Subcatchment 101: Post-101 Runoff Area=0.123 ac 99.09% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=98 Runoff=0.74 cfs 0.060 af

Subcatchment 102: Post-102 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=98 Runoff=0.74 cfs 0.060 af

Subcatchment 103: Post-103 Runoff Area=0.280 ac 68.27% Impervious Runoff Depth=5.40"
Tc=6.0 min CN=94 Runoff=1.62 cfs 0.126 af

Subcatchment 104: Post-104 Runoff Area=0.037 ac 1.00% Impervious Runoff Depth=2.07"
Tc=6.0 min CN=61 Runoff=0.09 cfs 0.006 af

Subcatchment 109: Post-109 Runoff Area=0.037 ac 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=98 Runoff=0.22 cfs 0.018 af

Subcatchment 110: Post-110 Runoff Area=0.124 ac 91.05% Impervious Runoff Depth=5.51"
Tc=6.0 min CN=95 Runoff=0.72 cfs 0.057 af

Subcatchment 111: Post-111 Runoff Area=0.156 ac 0.00% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=72 Runoff=0.56 cfs 0.040 af

Subcatchment 112: Post-112 Runoff Area=0.157 ac 0.29% Impervious Runoff Depth=3.47"
Tc=6.0 min CN=76 Runoff=0.64 cfs 0.045 af

Subcatchment 113: Post-113 Runoff Area=0.055 ac 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=98 Runoff=0.33 cfs 0.027 af

Subcatchment 114: Post-114 Runoff Area=0.114 ac 55.50% Impervious Runoff Depth=4.94"
Tc=6.0 min CN=90 Runoff=0.63 cfs 0.047 af

Subcatchment 200: Post-200 Runoff Area=0.233 ac 55.05% Impervious Runoff Depth=4.61"
Tc=6.0 min CN=87 Runoff=1.22 cfs 0.089 af

Subcatchment 300: Post-300 Runoff Area=0.326 ac 0.70% Impervious Runoff Depth=3.27"
Tc=6.0 min CN=74 Runoff=1.25 cfs 0.089 af

Subcatchment 301: Post-301 Runoff Area=0.307 ac 31.52% Impervious Runoff Depth=3.57"
Tc=6.0 min CN=77 Runoff=1.29 cfs 0.091 af

Subcatchment 302: Post-302 Runoff Area=0.078 ac 91.26% Impervious Runoff Depth=5.51"
Tc=6.0 min CN=95 Runoff=0.46 cfs 0.036 af

Reach 108R: 18" FES Inflow=3.64 cfs 0.291 af
Outflow=3.64 cfs 0.291 af

Reach 115R: Culvert Avg. Flow Depth=0.26' Max Vel=3.85 fps Inflow=0.63 cfs 0.047 af
12.00" Round Pipe n=0.011 L=72.0' S=0.0100 '/' Capacity=4.21 cfs Outflow=0.63 cfs 0.047 af

Pond 105P: Bypass MH Peak Elev=293.65' Inflow=3.57 cfs 0.284 af
Primary=0.65 cfs 0.209 af Secondary=2.92 cfs 0.075 af Outflow=3.57 cfs 0.284 af

Pond 107P: FocalPoint 121sf Peak Elev=292.87' Storage=243 cf Inflow=0.73 cfs 0.216 af
Outflow=0.73 cfs 0.216 af

Pond Bio-A: Bio - A Peak Elev=292.57' Storage=559 cf Inflow=0.72 cfs 0.057 af
Outflow=0.71 cfs 0.057 af

Pond Culvert: EX 48" Culvert Peak Elev=285.49' Inflow=5.88 cfs 0.460 af
48.00" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=5.88 cfs 0.460 af

Link 116: DP-1 Brook Across Sailor Way Inflow=6.73 cfs 0.525 af
Primary=6.73 cfs 0.525 af

Link 201: DP-2 Plainfield Pike CB Inflow=1.22 cfs 0.089 af
Primary=1.22 cfs 0.089 af

Link 303: DP-3 Plainfield/Sailor Intersection CBs Inflow=2.99 cfs 0.216 af
Primary=2.99 cfs 0.216 af

A3.5.4.6 HydroCAD 100-Year Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: Pre-10 Runoff Area=0.022 ac 100.00% Impervious Runoff Depth=8.46"
Tc=6.0 min CN=98 Runoff=0.19 cfs 0.016 af

Subcatchment 11: Pre-11 Runoff Area=0.019 ac 100.00% Impervious Runoff Depth=8.46"
Tc=6.0 min CN=98 Runoff=0.16 cfs 0.013 af

Subcatchment 12: Pre-12 Runoff Area=0.168 ac 100.00% Impervious Runoff Depth=8.46"
Tc=6.0 min CN=98 Runoff=1.43 cfs 0.118 af

Subcatchment 13: Pre-13 Runoff Area=0.162 ac 0.36% Impervious Runoff Depth=5.68"
Tc=6.0 min CN=75 Runoff=1.07 cfs 0.076 af

Subcatchment 14: Pre-14 Runoff Area=0.088 ac 67.03% Impervious Runoff Depth=7.74"
Tc=6.0 min CN=92 Runoff=0.73 cfs 0.057 af

Subcatchment 20: Pre-20 Runoff Area=0.405 ac 66.06% Impervious Runoff Depth=7.62"
Tc=6.0 min CN=91 Runoff=3.34 cfs 0.257 af

Subcatchment 30: Pre-30 Runoff Area=0.414 ac 22.28% Impervious Runoff Depth=6.16"
Tc=6.0 min CN=79 Runoff=2.94 cfs 0.213 af

Subcatchment 31: Pre-31 Runoff Area=0.323 ac 73.15% Impervious Runoff Depth=7.62"
Tc=6.0 min CN=91 Runoff=2.66 cfs 0.205 af

Link 15: DP-1 Brook Across Sailor Way Inflow=3.58 cfs 0.280 af
Primary=3.58 cfs 0.280 af

Link 21: DP-2 Plainfield Pike CB Inflow=3.34 cfs 0.257 af
Primary=3.34 cfs 0.257 af

Link 32: DP-3 Plainfield/Sailor Intersection CBs Inflow=5.60 cfs 0.417 af
Primary=5.60 cfs 0.417 af

Summary for Subcatchment 10: Pre-10

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.006	98	Impervious, HSG B
0.016	98	Impervious, HSG D
0.022	98	Weighted Average
0.022	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11: Pre-11

Runoff = 0.16 cfs @ 12.08 hrs, Volume= 0.013 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.019	98	Impervious, HSG B
0.019	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 12: Pre-12

Runoff = 1.43 cfs @ 12.08 hrs, Volume= 0.118 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.000	98	Impervious, HSG B
0.000	98	Impervious, HSG D
0.072	98	Roofs, HSG B
0.096	98	Roofs, HSG D
0.168	98	Weighted Average
0.168	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 13: Pre-13

Runoff = 1.07 cfs @ 12.09 hrs, Volume= 0.076 af, Depth= 5.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.016	61	>75% Grass cover, Good, HSG B
0.001	80	>75% Grass cover, Good, HSG D
0.000	98	Impervious, HSG B
0.000	98	Offsite Impervious, HSG B
0.000	98	Offsite Impervious, HSG D
0.145	77	Woods, Good, HSG D
0.162	75	Weighted Average
0.161	75	99.64% Pervious Area
0.001	98	0.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 14: Pre-14

Runoff = 0.73 cfs @ 12.08 hrs, Volume= 0.057 af, Depth= 7.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.029	80	>75% Grass cover, Good, HSG D
0.059	98	Impervious, HSG D
0.000	98	Offsite Impervious, HSG D
0.088	92	Weighted Average
0.029	80	32.97% Pervious Area
0.059	98	67.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 20: Pre-20

Runoff = 3.34 cfs @ 12.08 hrs, Volume= 0.257 af, Depth= 7.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.061	61	>75% Grass cover, Good, HSG B
0.034	80	>75% Grass cover, Good, HSG D
0.011	96	Gravel surface, HSG B
0.032	96	Gravel surface, HSG D
0.108	98	Impervious, HSG B
0.133	98	Impervious, HSG D
0.026	98	Offsite Impervious, HSG B
0.000	98	Offsite Impervious, HSG D
0.405	91	Weighted Average
0.137	76	33.94% Pervious Area
0.268	98	66.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 30: Pre-30

Runoff = 2.94 cfs @ 12.09 hrs, Volume= 0.213 af, Depth= 6.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.112	61	>75% Grass cover, Good, HSG B
0.210	80	>75% Grass cover, Good, HSG D
0.056	98	Impervious, HSG B
0.034	98	Impervious, HSG D
0.002	98	Offsite Impervious, HSG D
0.414	79	Weighted Average
0.322	73	77.72% Pervious Area
0.092	98	22.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 31: Pre-31

Runoff = 2.66 cfs @ 12.08 hrs, Volume= 0.205 af, Depth= 7.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
*	0.000	0	, HSG B
	0.036	61	>75% Grass cover, Good, HSG B
	0.050	80	>75% Grass cover, Good, HSG D
	0.165	98	Impervious, HSG B
	0.027	98	Impervious, HSG D
	0.019	98	Offsite Impervious, HSG B
	0.024	98	Offsite Impervious, HSG D
	0.000	98	Roofs, HSG B
	0.323	91	Weighted Average
	0.087	72	26.85% Pervious Area
	0.236	98	73.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Link 15: DP-1 Brook Across Sailor Way

Inflow Area = 0.458 ac, 58.52% Impervious, Inflow Depth = 7.34" for 100-Year event
Inflow = 3.58 cfs @ 12.08 hrs, Volume= 0.280 af
Primary = 3.58 cfs @ 12.08 hrs, Volume= 0.280 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 21: DP-2 Plainfield Pike CB

Inflow Area = 0.405 ac, 66.06% Impervious, Inflow Depth = 7.62" for 100-Year event
Inflow = 3.34 cfs @ 12.08 hrs, Volume= 0.257 af
Primary = 3.34 cfs @ 12.08 hrs, Volume= 0.257 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 32: DP-3 Plainfield/Sailor Intersection CBs

Inflow Area = 0.737 ac, 44.57% Impervious, Inflow Depth = 6.80" for 100-Year event
Inflow = 5.60 cfs @ 12.09 hrs, Volume= 0.417 af
Primary = 5.60 cfs @ 12.09 hrs, Volume= 0.417 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Pst-2: Existing Site Runoff Area=0.224 ac 95.98% Impervious Runoff Depth=8.34"
Tc=6.0 min CN=97 Runoff=1.91 cfs 0.156 af

Subcatchment Pst-3: Proposed Conditions Runoff Area=0.378 ac 87.83% Impervious Runoff Depth=8.10"
Tc=6.0 min CN=95 Runoff=3.20 cfs 0.255 af

Reach DP-1: Design Point Inflow=5.04 cfs 0.406 af
Outflow=5.04 cfs 0.406 af

Pond Bio-A: Bio - A Peak Elev=292.70' Storage=636 cf Inflow=3.18 cfs 0.250 af
Outflow=3.16 cfs 0.250 af

Pond Culvert: EX 48" Culvert Peak Elev=285.43' Storage=0.000 af Inflow=5.04 cfs 0.406 af
48.0" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=5.04 cfs 0.406 af

Pond FB: Sediment Forebay Peak Elev=292.81' Storage=255 cf Inflow=3.18 cfs 0.255 af
Outflow=3.18 cfs 0.250 af

Pond ST: Stone Storage Area Peak Elev=292.52' Storage=1,590 cf Inflow=3.20 cfs 0.255 af
Outflow=3.18 cfs 0.255 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100: Post-100 Runoff Area=0.078 ac 100.00% Impervious Runoff Depth=8.46"
Tc=6.0 min CN=98 Runoff=0.67 cfs 0.055 af

Subcatchment 101: Post-101 Runoff Area=0.123 ac 99.09% Impervious Runoff Depth=8.46"
Tc=6.0 min CN=98 Runoff=1.05 cfs 0.087 af

Subcatchment 102: Post-102 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=8.46"
Tc=6.0 min CN=98 Runoff=1.05 cfs 0.087 af

Subcatchment 103: Post-103 Runoff Area=0.280 ac 68.27% Impervious Runoff Depth=7.98"
Tc=6.0 min CN=94 Runoff=2.35 cfs 0.186 af

Subcatchment 104: Post-104 Runoff Area=0.037 ac 1.00% Impervious Runoff Depth=3.99"
Tc=6.0 min CN=61 Runoff=0.17 cfs 0.012 af

Subcatchment 109: Post-109 Runoff Area=0.037 ac 100.00% Impervious Runoff Depth=8.46"
Tc=6.0 min CN=98 Runoff=0.32 cfs 0.026 af

Subcatchment 110: Post-110 Runoff Area=0.124 ac 91.05% Impervious Runoff Depth=8.10"
Tc=6.0 min CN=95 Runoff=1.04 cfs 0.083 af

Subcatchment 111: Post-111 Runoff Area=0.156 ac 0.00% Impervious Runoff Depth=5.31"
Tc=6.0 min CN=72 Runoff=0.97 cfs 0.069 af

Subcatchment 112: Post-112 Runoff Area=0.157 ac 0.29% Impervious Runoff Depth=5.80"
Tc=6.0 min CN=76 Runoff=1.06 cfs 0.076 af

Subcatchment 113: Post-113 Runoff Area=0.055 ac 100.00% Impervious Runoff Depth=8.46"
Tc=6.0 min CN=98 Runoff=0.47 cfs 0.039 af

Subcatchment 114: Post-114 Runoff Area=0.114 ac 55.50% Impervious Runoff Depth=7.50"
Tc=6.0 min CN=90 Runoff=0.93 cfs 0.071 af

Subcatchment 200: Post-200 Runoff Area=0.233 ac 55.05% Impervious Runoff Depth=7.13"
Tc=6.0 min CN=87 Runoff=1.84 cfs 0.138 af

Subcatchment 300: Post-300 Runoff Area=0.326 ac 0.70% Impervious Runoff Depth=5.56"
Tc=6.0 min CN=74 Runoff=2.11 cfs 0.151 af

Subcatchment 301: Post-301 Runoff Area=0.307 ac 31.52% Impervious Runoff Depth=5.92"
Tc=6.0 min CN=77 Runoff=2.11 cfs 0.152 af

Subcatchment 302: Post-302 Runoff Area=0.078 ac 91.26% Impervious Runoff Depth=8.10"
Tc=6.0 min CN=95 Runoff=0.66 cfs 0.053 af

Reach 108R: 18" FES Inflow=5.29 cfs 0.427 af
Outflow=5.29 cfs 0.427 af

Reach 115R: Culvert Avg. Flow Depth=0.32' Max Vel=4.30 fps Inflow=0.93 cfs 0.071 af
12.00" Round Pipe n=0.011 L=72.0' S=0.0100 '/' Capacity=4.21 cfs Outflow=0.93 cfs 0.071 af

Pond 105P: Bypass MH Peak Elev=293.75' Inflow=5.13 cfs 0.415 af
Primary=0.69 cfs 0.286 af Secondary=4.44 cfs 0.129 af Outflow=5.13 cfs 0.415 af

Pond 107P: FocalPoint 121sf Peak Elev=292.90' Storage=250 cf Inflow=0.86 cfs 0.298 af
Outflow=0.86 cfs 0.298 af

Pond Bio-A: Bio - A Peak Elev=292.59' Storage=571 cf Inflow=1.04 cfs 0.083 af
Outflow=1.04 cfs 0.083 af

Pond Culvert: EX 48" Culvert Peak Elev=285.69' Inflow=8.81 cfs 0.694 af
48.00" Round Culvert n=0.011 L=136.0' S=0.0066 '/' Outflow=8.81 cfs 0.694 af

Link 116: DP-1 Brook Across Sailor Way Inflow=10.06 cfs 0.792 af
Primary=10.06 cfs 0.792 af

Link 201: DP-2 Plainfield Pike CB Inflow=1.84 cfs 0.138 af
Primary=1.84 cfs 0.138 af

Link 303: DP-3 Plainfield/Sailor Intersection CBs Inflow=4.88 cfs 0.355 af
Primary=4.88 cfs 0.355 af

Summary for Subcatchment 100: Post-100

Runoff = 0.67 cfs @ 12.08 hrs, Volume= 0.055 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.034	98	Roofs, HSG B
0.044	98	Roofs, HSG D
0.078	98	Weighted Average
0.078	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 101: Post-101

Runoff = 1.05 cfs @ 12.08 hrs, Volume= 0.087 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.001	80	>75% Grass cover, Good, HSG D
0.039	98	Impervious, HSG B
0.084	98	Impervious, HSG D
0.000	98	Roofs, HSG B
0.123	98	Weighted Average
0.001	80	0.91% Pervious Area
0.122	98	99.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 102: Post-102

Runoff = 1.05 cfs @ 12.08 hrs, Volume= 0.087 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.056	98	Roofs, HSG B
0.067	98	Roofs, HSG D
0.123	98	Weighted Average
0.123	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 103: Post-103

Runoff = 2.35 cfs @ 12.08 hrs, Volume= 0.186 af, Depth= 7.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.007	61	>75% Grass cover, Good, HSG B
0.039	80	>75% Grass cover, Good, HSG D
0.042	96	Gravel surface, HSG D
0.056	98	Impervious, HSG B
0.135	98	Impervious, HSG D
0.280	94	Weighted Average
0.089	86	31.73% Pervious Area
0.191	98	68.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 104: Post-104

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 0.012 af, Depth= 3.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.037	61	>75% Grass cover, Good, HSG B
0.000	98	Impervious, HSG B
0.037	61	Weighted Average
0.037	61	99.00% Pervious Area
0.000	98	1.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 109: Post-109

Runoff = 0.32 cfs @ 12.08 hrs, Volume= 0.026 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
*	0.000	0	, HSG B
	0.025	98	Impervious, HSG B
	0.012	98	Offsite Impervious, HSG B
	0.037	98	Weighted Average
	0.000	0	0.00% Pervious Area
	0.037	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 110: Post-110

Runoff = 1.04 cfs @ 12.08 hrs, Volume= 0.083 af, Depth= 8.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.011	61	>75% Grass cover, Good, HSG B
0.000	80	>75% Grass cover, Good, HSG D
0.069	98	Impervious, HSG B
0.034	98	Impervious, HSG D
0.010	98	Roofs, HSG B
0.124	95	Weighted Average
0.011	61	8.95% Pervious Area
0.112	98	91.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 111: Post-111

Runoff = 0.97 cfs @ 12.09 hrs, Volume= 0.069 af, Depth= 5.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.067	61	>75% Grass cover, Good, HSG B
0.086	80	>75% Grass cover, Good, HSG D
0.003	77	Woods, Good, HSG D
0.156	72	Weighted Average
0.156	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 112: Post-112

Runoff = 1.06 cfs @ 12.09 hrs, Volume= 0.076 af, Depth= 5.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.011	61	>75% Grass cover, Good, HSG B
0.001	80	>75% Grass cover, Good, HSG D
0.000	98	Offsite Impervious, HSG B
0.000	98	Offsite Impervious, HSG D
0.000	55	Woods, Good, HSG B
0.145	77	Woods, Good, HSG D
0.157	76	Weighted Average
0.156	76	99.71% Pervious Area
0.000	98	0.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 113: Post-113

Runoff = 0.47 cfs @ 12.08 hrs, Volume= 0.039 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.014	98	Impervious, HSG B
0.041	98	Impervious, HSG D
0.055	98	Weighted Average
0.055	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 114: Post-114

Runoff = 0.93 cfs @ 12.08 hrs, Volume= 0.071 af, Depth= 7.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.051	80	>75% Grass cover, Good, HSG D
0.063	98	Impervious, HSG D
0.114	90	Weighted Average
0.051	80	44.50% Pervious Area
0.063	98	55.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 200: Post-200

Runoff = 1.84 cfs @ 12.08 hrs, Volume= 0.138 af, Depth= 7.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.058	61	>75% Grass cover, Good, HSG B
0.027	80	>75% Grass cover, Good, HSG D
0.011	96	Gravel surface, HSG B
0.009	96	Gravel surface, HSG D
0.076	98	Impervious, HSG B
0.018	98	Impervious, HSG D
0.034	98	Offsite Impervious, HSG B
0.000	98	Offsite Impervious, HSG D
0.000	98	Roofs, HSG B
0.233	87	Weighted Average
0.105	73	44.95% Pervious Area
0.128	98	55.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 300: Post-300

Runoff = 2.11 cfs @ 12.09 hrs, Volume= 0.151 af, Depth= 5.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.113	61	>75% Grass cover, Good, HSG B
0.210	80	>75% Grass cover, Good, HSG D
0.002	98	Offsite Impervious, HSG D
0.326	74	Weighted Average
0.323	73	99.30% Pervious Area
0.002	98	0.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 301: Post-301

Runoff = 2.11 cfs @ 12.09 hrs, Volume= 0.152 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.144	61	>75% Grass cover, Good, HSG B
0.067	80	>75% Grass cover, Good, HSG D
0.058	98	Impervious, HSG B
0.017	98	Impervious, HSG D
0.007	98	Offsite Impervious, HSG B
0.015	98	Offsite Impervious, HSG D
0.307	77	Weighted Average
0.211	67	68.48% Pervious Area
0.097	98	31.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 302: Post-302

Runoff = 0.66 cfs @ 12.08 hrs, Volume= 0.053 af, Depth= 8.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.007	61	>75% Grass cover, Good, HSG B
0.072	98	Impervious, HSG B
0.078	95	Weighted Average
0.007	61	8.74% Pervious Area
0.072	98	91.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach 108R: 18" FES

Inflow Area = 0.642 ac, 80.29% Impervious, Inflow Depth = 7.99" for 100-Year event
Inflow = 5.29 cfs @ 12.08 hrs, Volume= 0.427 af
Outflow = 5.29 cfs @ 12.08 hrs, Volume= 0.427 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

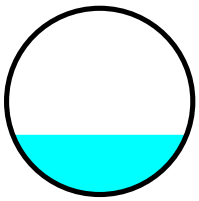
Summary for Reach 115R: Culvert

Inflow Area = 0.114 ac, 55.50% Impervious, Inflow Depth = 7.50" for 100-Year event
Inflow = 0.93 cfs @ 12.08 hrs, Volume= 0.071 af
Outflow = 0.93 cfs @ 12.09 hrs, Volume= 0.071 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.30 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.40 fps, Avg. Travel Time= 0.9 min

Peak Storage= 16 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.32' , Surface Width= 0.93'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.21 cfs

12.00" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 72.0' Slope= 0.0100 '/'
Inlet Invert= 284.40', Outlet Invert= 283.68'



Summary for Pond 105P: Bypass MH

Inflow Area = 0.605 ac, 85.14% Impervious, Inflow Depth = 8.24" for 100-Year event
Inflow = 5.13 cfs @ 12.08 hrs, Volume= 0.415 af
Outflow = 5.13 cfs @ 12.08 hrs, Volume= 0.415 af, Atten= 0%, Lag= 0.0 min
Primary = 0.69 cfs @ 12.08 hrs, Volume= 0.286 af
Secondary = 4.44 cfs @ 12.08 hrs, Volume= 0.129 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 293.75' @ 12.08 hrs
Flood Elev= 296.00'

Device	Routing	Invert	Outlet Devices
#1	Secondary	291.00'	**12.00" Round To Storm Sewer** L= 34.3' Ke= 0.500 Inlet / Outlet Invert= 291.00' / 289.30' S= 0.0496 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	292.65'	**6.00" Round To Wq**

L= 37.1' CPP, projecting, no headwall, Ke= 0.900
Inlet / Outlet Invert= 292.65' / 292.25' S= 0.0108 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.20 sf

#3	Device 1	293.33'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.69 cfs @ 12.08 hrs HW=293.75' TW=292.90' (Dynamic Tailwater)
└**2=To Wq** (Inlet Controls 0.69 cfs @ 3.51 fps)

Secondary OutFlow Max=4.43 cfs @ 12.08 hrs HW=293.75' TW=0.00' (Dynamic Tailwater)
└**1=To Storm Sewer** (Passes 4.43 cfs of 5.68 cfs potential flow)
└**3=Sharp-Crested Rectangular Weir** (Weir Controls 4.43 cfs @ 2.13 fps)

Summary for Pond 107P: FocalPoint 121sf

Inflow Area = 0.642 ac, 80.29% Impervious, Inflow Depth = 5.58" for 100-Year event
Inflow = 0.86 cfs @ 12.09 hrs, Volume= 0.298 af
Outflow = 0.86 cfs @ 12.10 hrs, Volume= 0.298 af, Atten= 1%, Lag= 0.9 min
Primary = 0.86 cfs @ 12.10 hrs, Volume= 0.298 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 292.90' @ 12.10 hrs Surf.Area= 121 sf Storage= 250 cf

Plug-Flow detention time= 4.1 min calculated for 0.298 af (100% of inflow)
Center-of-Mass det. time= 4.1 min (766.7 - 762.6)

Volume	Invert	Avail.Storage	Storage Description
#1	289.75'	54 cf	**11.00'W x 11.00'L x 2.25'H FocalPoint** 272 cf Overall x 20.0% Voids
#2	292.00'	524 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
		578 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
292.00	133	0	0
293.00	323	228	228
294.00	269	296	524

Device	Routing	Invert	Outlet Devices
#1	Device 3	289.75'	**100.000 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Device 3	292.75'	**12.00" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	289.00'	**8.00" Round Culvert** L= 21.0' Ke= 0.500 Inlet / Outlet Invert= 289.00' / 288.75' S= 0.0119 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.86 cfs @ 12.10 hrs HW=292.90' TW=0.00' (Dynamic Tailwater)
└**3=Culvert** (Passes 0.86 cfs of 3.17 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.28 cfs)
└**2=Orifice/Grate** (Weir Controls 0.58 cfs @ 1.25 fps)

Summary for Pond Bio-A: Bio - A

Inflow Area = 0.124 ac, 91.05% Impervious, Inflow Depth = 8.10" for 100-Year event
Inflow = 1.04 cfs @ 12.08 hrs, Volume= 0.083 af
Outflow = 1.04 cfs @ 12.09 hrs, Volume= 0.083 af, Atten= 1%, Lag= 0.6 min
Primary = 1.04 cfs @ 12.09 hrs, Volume= 0.083 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 292.59' @ 12.09 hrs Surf.Area= 910 sf Storage= 571 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 76.3 min (831.6 - 755.3)

Volume	Invert	Avail.Storage	Storage Description
#1	291.75'	475 cf	**Ponding Area (Prismatic)** Listed below (Recalc)
#2	290.00'	192 cf	**Mulch, Bio-media and Pea Gravel (Prismatic)** Listed below (Recalc) 581 cf Overall x 33.0% Voids
		666 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
291.75	332	0	0
292.50	540	327	327
292.75	642	148	475

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.00	332	0	0
291.75	332	581	581

Device	Routing	Invert	Outlet Devices
#1	Primary	292.50'	**14.0' long x 3.0' breadth Overflow** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	290.00'	**2.410 in/hr Subdrain over Surface area**

Primary OutFlow Max=1.03 cfs @ 12.09 hrs HW=292.59' TW=285.69' (Dynamic Tailwater)
└─**1=Overflow** (Weir Controls 0.98 cfs @ 0.75 fps)
└─**2=Subdrain** (Exfiltration Controls 0.05 cfs)

Summary for Pond Culvert: EX 48" Culvert

Inflow Area = 1.132 ac, 60.30% Impervious, Inflow Depth = 7.35" for 100-Year event
Inflow = 8.81 cfs @ 12.09 hrs, Volume= 0.694 af
Outflow = 8.81 cfs @ 12.09 hrs, Volume= 0.694 af, Atten= 0%, Lag= 0.0 min
Primary = 8.81 cfs @ 12.09 hrs, Volume= 0.694 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Peak Elev= 285.69' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	284.66'	**48.00" Round Culvert** L= 136.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 284.66' / 283.76' S= 0.0066 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 12.57 sf

Primary OutFlow Max=8.80 cfs @ 12.09 hrs HW=285.69' TW=0.00' (Dynamic Tailwater)
1=Culvert (Barrel Controls 8.80 cfs @ 5.14 fps)

Summary for Link 116: DP-1 Brook Across Sailor Way

Inflow Area = 1.284 ac, 61.03% Impervious, Inflow Depth = 7.40" for 100-Year event
Inflow = 10.06 cfs @ 12.09 hrs, Volume= 0.792 af
Primary = 10.06 cfs @ 12.09 hrs, Volume= 0.792 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 201: DP-2 Plainfield Pike CB

Inflow Area = 0.233 ac, 55.05% Impervious, Inflow Depth = 7.13" for 100-Year event
Inflow = 1.84 cfs @ 12.08 hrs, Volume= 0.138 af
Primary = 1.84 cfs @ 12.08 hrs, Volume= 0.138 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 303: DP-3 Plainfield/Sailor Intersection CBs

Inflow Area = 0.711 ac, 24.01% Impervious, Inflow Depth = 5.99" for 100-Year event
Inflow = 4.88 cfs @ 12.09 hrs, Volume= 0.355 af
Primary = 4.88 cfs @ 12.09 hrs, Volume= 0.355 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

A3.5.4.7 2012 Stormwater Management Report by DiPrete Engineering

DiPrete Engineering

Stormwater Management Report

2050 Plainfield Pike

Located in Cranston, Rhode Island

Applicant: DSD Enterprises, LLC

11-13-2012

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Executive Summary

On behalf of the Client, we are submitting drainage calculations for the proposed development at 2050 Plainfield Pike. The site is located on Assessors' Plat 36/2 Lot 117. The site exists today with the majority of area developed with pavement and buildings. The southern portion of the site is wooded. The client proposes to fill a portion of a wetland area onsite to construct a stone storage area for vehicles waiting to be maintained.

The post development stormwater will be treated for water quality using Best Management Practices (BMPs). The Site has been designed to meet the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM) Final December 2010. The area being developed has a high watertable.

Under the RISDISM, the site is not considered a redevelopment site since less than 10,000 SF of existing impervious area will be disturbed. The site provides full water quality treatment of the proposed stone storage area. Additional water quality treatment (50%) is provided for the portion of existing paved areas onsite which sheet flow to towards the C-Series Wetland. Recharge has not been incorporated into the design as this is infeasible due to the high water table. The site meets the RISDISM through a Best Management Practice (BMP). This practice is a sediment forebay and bioretention area.

The bio retention area is designed as a water quality BMP and will remove 85% or more of TSS (total suspended solids) generated by the proposed stone storage area.

This report details how the proposed development will have no net increase in stormwater runoff from the 1-Year through 25-Year design storms and a negligible increase in stormwater runoff from the 100-Year design storm from pre development to post development conditions. This report will also provide water quality treatment for stormwater runoff, as well as providing provisions for erosion control on site.

Pre development Conditions versus Post Development Conditions for each watershed are summarized below:

Watershed #1: (DP-1)

Conditions	1-Year	10-Year	25-Year	100-Year
Pre Dev Summation	8.10 cfs	22.56 cfs	31.00 cfs	49.57 cfs
Post Dev Summation	7.53 cfs	21.68 cfs	30.98 cfs	49.75 cfs
Net Change	**-0.57 cfs**	**-0.88 cfs**	**-0.02 cfs**	**+0.18 cfs**

(cfs = cubic feet per second)

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APPENDIX A: STORMWATER MANAGEMENT CHECKLIST

The first thing that applicants and designers must do before beginning a project is to make sure they are familiar with the 11 minimum standards listed in Manual Chapter Three, as projects must meet all 11 standards. Next, designers should review the available LID site planning and design strategies and BMPs in Manual Chapters Four through Seven to determine which would work best at their site. This checklist serves as a guide for engineers and designers to refer to during all stages of a project to ensure that they are meeting all applicable requirements. In addition, designers must include a completed checklist with their final stormwater management plan.

A.1 CHECKLIST FOR STORMWATER MANAGEMENT PLAN PREPARATION AND REVIEW

A.1.1 General Information

- ☑ Applicant name, mailing address, and telephone number
- ☑ Contact information for the licensed professional(s) responsible for site plans and stormwater management plan
- ☑ Common address and legal description of project site
- ☑ Vicinity map
- ☑ Existing zoning and land use at the project site
- ☑ Proposed land use – indicate if land use meets definition of a LUHPPL (see Manual Table 3-2)
- ☑ General Project Narrative
- ☑ Project type (new development or redevelopment)

A.1.2 Existing and Proposed Mapping and Plans

- ☑ Existing and proposed mapping and plans (scale not greater than 1" = 40') with North arrow that illustrate at a minimum:
  - ☑ Existing and proposed site topography (2-foot contours required). 10-foot contours accepted for off-site areas.
  - ☑ Existing and proposed drainage area delineations and drainage flow paths, mapped according to the DEM *Guidance for Preparation of Drainage Area Maps* (included in Appendix K). Drainage area boundaries need to be complete; include off-site areas in both mapping and analyses, as applicable.
  - ☑ Perennial and intermittent streams, in addition to areas subject to storm flowage (ASSFs)

- ☑ Mapping of predominant soils from USDA soil surveys, especially hydric soil groups as well as location of site-specific borings and/or test pits (on drainage area maps only – not site plans)
- ☑ Boundaries of existing predominant vegetation and proposed limits of clearing
- ☑ Location and field-verified boundaries of resource protection areas such as freshwater and coastal wetlands, lakes, ponds, coastal shoreline features and required setbacks (e.g., buffers, water supply wells, septic systems)
- ☑ Location of floodplain and, if applicable, floodway limits and relationship of site to upstream and downstream properties and drainages
- ☑ Location of existing and proposed roads, buildings, and other structures including limits of disturbance
- ☑ Existing and proposed utilities (e.g., water, sewer, gas, electric) and easements
- ☑ Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains
- ☐ Location and dimensions of channel modifications, such as bridge or culvert crossings
- ☑ Location, size, and limits of proposed LID planning and site design techniques (type of practice, depth, area). LID techniques should be labeled clearly on the plan and a key should be provided that corresponds to a tabular description.
- ☑ Location, size, and limits of disturbance of proposed stormwater treatment practices (type of practice, depth, area). Stormwater treatment practices (BMPs) should be labeled with numbers that correspond to the table in Section A.1.5.
- ☐ Soils information from test pits or borings at the location of proposed stormwater management facilities, including but not limited to soil descriptions, depth to seasonal high groundwater, depth to bedrock, and estimated hydraulic conductivity. Soils information will be based on site test pits or borings logged by a DEM-licensed Class IV soil evaluator or RI-registered PE.
- ☑ 8.5 x 11 inch copy of site plan for public notice, as applicable.

A.1.3 Minimum Stormwater Management Standards

☑ **Minimum Standard 1: LID Site Planning and Design Strategies**

Document specific LID site planning and design strategies and associated methods that were employed for the project in the following table:

LID Site Planning and Design Checklist

The applicant must document specific LID site planning and design strategies applied for the project (see Manual Chapter Four and the *RI Community LID Guidance Manual* for more details regarding each strategy). If a particular strategy was not used, a justification and description of proposed alternatives must be provided. If a strategy is not applicable (N/A), applicants must describe why a certain method is not applicable at their site. For example, preserving wetland buffers may be not applicable for sites located outside any jurisdictional wetland buffers. In communities where conservation development or other low-impact development site planning and design processes exist, following the local community conservation development option may help a project achieve this standard.

1. Strategies to Avoid the Impacts

A. Preservation of Undisturbed Areas

☑ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☑ Limits of disturbance clearly marked on all construction plans.
- ☑ Mapped soils by Hydrologic Soil Group (HSG).
- ☐ Building envelopes avoid steep slopes, forest stands, riparian corridors, HSG D soils, and floodplains.
- ☐ New lots, to the extent practicable, have been kept out of freshwater and coastal wetland jurisdictional areas.
- ☐ Important natural areas (i.e., undisturbed forest, riparian corridors, and wetlands) identified and protected with permanent conservation easement.
- ☐ Percent of natural open space calculation is provided.
- ☐ Other (describe):

Explain constraints when a strategy is applied and/or proposed alternatives in space below:

Existing site is developed and the proposed development is to expand an area for onsite storage. The only available area is the undeveloped southern portion of the site. Additional water quality treatment of existing paved areas is being provided in addition to water quality treatment of the proposed stone storage area.

B. Preservation of Buffers and Floodplains

☑ Not Applied or N/A. *Use space below to explain why:*

Select from the following:

- ☐ Applicable vegetated buffers of coastal and freshwater wetlands and perennial and intermittent streams have been preserved, where possible.
- ☐ Limits of disturbance included on all construction plans that protect applicable buffers
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

Existing site is developed and the proposed development is to expand an area for onsite storage. The only available area is the undeveloped southern portion of the site. Additional water quality treatment of existing paved areas is being provided in addition to water quality treatment of the proposed stone storage area.

LID Site Planning and Design Checklist

C. Minimized Clearing and Grading

☑ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☑ Site fingerprinting to extent needed for building footprints, construction access and safety (i.e., clearing and grading limited to 15 feet beyond building pad or 5 feet beyond road bed/shoulder).
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

Existing site is developed and the proposed development is to expand an area for onsite storage. The only available area is the undeveloped southern portion of the site. Additional water quality treatment of existing paved areas is being provided in addition to water quality treatment of the proposed stone storage area. The limit of disturbance has been limited to the extent needed for the proposed stone storage area.

D. Locating Sites in Less Sensitive Areas

☑ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☐ A site design process, such as conservation development, used to avoid or minimize impacts to sensitive resources such as floodplains, steep slopes, erodible soils, wetlands, hydric soils, surface waters, and their riparian buffers.
- ☐ Development located in areas with least hydrologic value (e.g., soil groups A and B)
- ☐ Development on steep slopes, grading and flattening of ridges has been avoided to the maximum extent practicable.
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

The proposed expansion is located in the only undeveloped area remaining on site.

E. Compact Development

☑ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☐ A site design technique (e.g., conservation development) used to concentrate development to preserve as much undisturbed open space as practicable and reduce impervious cover.
- ☐ Reduced setbacks, frontages, and right- of- way widths have been used where practicable.
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

The proposed expansion is located in the only undeveloped area remaining on site. The limit of disturbance has been limited to the extent needed for the proposed stone storage area.

LID Site Planning and Design Checklist

F. Work with the Natural Landscape Conditions, Hydrology, and Soils

☐ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☑ Stormwater management system mimics pre-development hydrology to retain and attenuate runoff in upland areas (e.g., cuts and fills limited and BMPs distributed throughout site; trees used for interception and uptake).
- ☑ The post-development time of concentration (t_c) should approximate pre-development t_c.
- ☑ Flow velocity in graded areas as low as practicable to avoid soil erosion (i.e., slope grade minimized). Velocities shall not exceed velocities in Appendix B, Table B-2.
- ☐ Plans show measures to prevent soil compaction in areas designated as Qualified Pervious Areas (QPAs) for better infiltration.
- ☐ Site designed to locate buildings, roadways and parking to minimize grading (cut and fill quantities)
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

Additional water quality treatment of existing paved areas is being provided in addition to water quality treatment of the proposed stone storage area.

2. Strategies to Reduce the Impacts

Reduce Impervious Cover

☐ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☐ Reduced roadway widths
- ☐ Reduce driveway areas
- ☐ Reduced building footprint
- ☐ Reduced sidewalk area
- ☐ Reduced cul-de-sacs
- ☑ Reduced parking lot area
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

The storage area has been reduced to the maximum extent practicable. Vehicles waiting to be stored will be double stacked within the storage area and additional drive aisles have not been provided.

3. Strategies to Manage the Impacts

A. Disconnecting Impervious Area

☑ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☐ Impervious surfaces have been disconnected to QPAs to the extent possible.
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

Water quality treatment is provided by a sediment forebay and bioretention area.

LID Site Planning and Design Checklist

B. Mitigation of Runoff at the point of generation

☐ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☐ Roof runoff has been directed to a QPA, such as a yard or vegetated area.
- ☐ Roof runoff has been directed to a lower impact practice such as a rain barrel or cistern.
- ☐ A green roof has been designed to reduce runoff.
- ☐ Small-scale BMPs applied at source.
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

Water quality treatment is provided by a sediment forebay and bioretention area.

C. Stream/Wetland Restoration

☑ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☐ Historic drainage patterns have been restored by removing closed drainage systems and/or restoring degraded stream channels and/or wetlands.
- ☐ Removal of invasive species.
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

Project proposes to fill wetland area. Wetland/Wetland buffer plantings are proposed.

D. Reforestation

☑ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☐ Low maintenance, native vegetation has been proposed.
- ☐ Trees are proposed to be planted or conserved to reduce runoff volume, increase nutrient uptake, and provide shading and habitat.
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

Project proposes to clear wooded area. Wetland/Wetland buffer plantings are proposed.

E. Source Control

☐ Not Applied or N/A. *Use space below to explain why:*

Select from the following list:

- ☑ Source control techniques such as street sweeping or pet waste management have been proposed.
- ☐ Other (describe):

Explain constraints and/or proposed alternatives in space below:

Street sweeping of the existing pavement areas is proposed. No new paved surfaces are proposed.

☑ **Minimum Standard 2: Groundwater Recharge** (N/A)

Demonstrate that groundwater recharge criteria for the site have been met. Include:

☐ The required recharge volume (Re_v) in acre-feet (See Manual Section 3.3.2)

☐ LID Stormwater Credit from Checklist Section A.1.4 to be applied to recharge requirement, if applicable, with the following calculations (See Manual Section 4.6.1):

- the recharge area (Re_a) in acres for the site
- the site impervious area draining to QPAs
- the new Re_v requirement

☐ Specific BMPs from Checklist Section A.1.5 that will be used to meet the recharge requirement. *Note: Only BMPs listed in Manual Table 3-5, List of BMPs Acceptable for Recharge may be used to meet the recharge requirement.*

☑ **Minimum Standard 3: Water Quality**

Demonstrate that the water quality criteria for the site have been met. Include:

☑ Required water quality volume (WQ_v) in acre-feet or ft^3 (see Manual Section 3.3.3).

☐ LID Stormwater Credit from Checklist Section A.1.4 to be applied to water quality requirement, if applicable, with the following calculations (see Manual Section 4.6.1):

- the new impervious area (in acres) for the site
- the new WQ_v in acre-feet or ft^3

☑ Specific BMPs from Checklist Section A.1.5 that will be used to meet water quality volume requirement. *Note: Only BMPs listed in Manual Table 3-6, Acceptable BMPs for Water Quality Treatment may be used to meet the water quality requirement.*

☐ Specify any additional pollutant-specific requirements and/or pollutant removal efficiencies applicable to the site as the result of SAMP, TMDL, or other watershed-specific requirements.

☑ **Minimum Standard 4: Conveyance and Natural Channel Protection**

Demonstrate that the conveyance and natural channel protection criteria for the site have been met. Include:

☑ Justification for channel protection criterion waiver, if applicable (see Manual Section 3.3.4).

☐ Required channel protection volume (CP_v) (see Manual Section 3.3.4).

☐ Specific BMPs from Checklist Section A.1.5 that will be used to meet the channel protection requirement. Hydrologic and hydraulic site evaluation as described in Manual Section 3.3.4 should be included in Checklist Section A.1.5 for each channel protection BMP.

☑ **Minimum Standard 5: Overbank Flood Protection**

Demonstrate that the overbank flood protection criteria for the site have been met. Include:

☐ Justification for overbank flood protection criterion waiver, if applicable (see Manual Section 3.3.5).

☑ Pre- and post-development peak discharge rates.

☑ Specific BMPs from Checklist Section A.1.5 that will be used to meet the overbank flood protection requirement. Hydrologic and hydraulic site evaluation as described in Manual Section 3.3.4 should be included in Checklist Section A.1.5 for each overbank flood protection BMP.

☑ **Minimum Standard 6: Redevelopment and Infill Projects**

Demonstrate that criteria for redevelopment and/or infill projects have been met, if applicable. Include:

☐ Description of site that meets redevelopment/infill definition.

☐ Approved off-site location within watershed where stormwater management requirements will be met, if applicable (see Manual Section 3.2.6).

☑ Not Applicable.

☑ **Minimum Standard 7: Pollution Prevention**

Demonstrate that the project meets the criteria for pollution prevention. Include:

☑ Stormwater pollution prevention plan

☑ **Minimum Standard 8: LUHPPLs**

Demonstrate that the project meets the criteria for LUHPPLs, if applicable. Include:

☑ Description of any land use activities considered stormwater LUHPPL (see Manual Table 3-2).

☑ Specific BMPs listed in Checklist Section A.1.5 that receive stormwater from LUHPPL drainage areas. These BMP types must be listed in Manual Table 3-3, "Acceptable BMPs for Use at LUHPPLs."

☐ Additional BMPs, if any, that meet RIPDES MSGP requirements.

☐ Not Applicable.

☑ **Minimum Standard 9: Illicit Discharges**

Applicant asserts that no illicit discharges exist or are proposed to the stormwater management system in accordance with State regulations.

☑ **Minimum Standard 10: Construction Erosion and Sedimentation Control**

Demonstrate that ESC practices will be used during the construction phase and land disturbing activities. Include:

☑ Description of temporary sediment trapping and conveyance practices, including sizing calculations and method of temporary and permanent stabilization (see Manual Section 3.2.9 and *the Rhode Island Soil Erosion and Sediment Control Handbook*).

☑ Description of sequence of construction. Activities should be phased to avoid compacting soil during construction, particularly in the location of infiltrating stormwater practices and qualifying pervious areas for stormwater credits.

☑ Location of construction staging and material stockpiling areas.

☑ **Minimum Standard 11: Stormwater Management System Operation and Maintenance**

Provide a stormwater management system operation and maintenance plan that at a minimum includes:

☑ Name, address, and phone number of responsible parties for maintenance

☑ Description of annual maintenance tasks

☑ Description of applicable easements

☑ Description of funding source

☑ Minimum vegetative cover requirements

☑ Access and safety issues

A.1.4 LID Stormwater Credit

Description of stormwater credit, if applicable. Label qualifying pervious areas (QPAs) on the site map, and document that all stormwater credit requirements listed in Section 4.6 are met. For each QPA, note the impervious area (in acres) that drains to it, and place a check in the appropriate box to demonstrate that it meets the following criteria:

	QPA 1	QPA 2	QPA 3	QPA 4
Impervious Area Draining to QPA (acres)				
QPA Criteria	**Criterion Met?**			
Construction vehicles shall not be allowed to drive over the QPA during construction. If the area becomes compacted, soil must be suitably amended, tilled, and revegetated once construction is complete to restore infiltration capacity.	☐	☐	☐	☐
QPA infiltration area is at least 10ft from building foundation.	☐	☐	☐	☐

	QPA 1	QPA 2	QPA 3	QPA 4
Contributing impervious area does not exceed 1,000 ft^2.	☐	☐	☐	☐
Length of QPA in feet is equal to or greater than the contributing rooftop area in ft^2 divided by 13.3. The maximum contributing flow path from non-rooftop impervious areas is 75ft.	☐	☐	☐	☐
QPA does not overlap any other QPA.	☐	☐	☐	☐
Lot is greater than 6,000 ft^2.	☐	☐	☐	☐
The slope of the QPA is less than or equal to 5.0%.	☐	☐	☐	☐
Disconnected downspouts draining to QPA are at least 10 feet away from the nearest impervious surface.	☐	☐	☐	☐
Runoff from rooftops without gutters / downspouts that drains to QPA flows away from the structure as low-velocity sheet flow.	☐	☐	☐	☐
QPA is located on Hydrologic Soil Group (HSG) A or B soils.	☐	☐	☐	☐
Depth to groundwater within QPA is 18 inches or greater (has been confirmed by evaluation by a DEM-licensed Class IV soil evaluator or RI-registered PE).	☐	☐	☐	☐
Runoff is directed over soft shoulders, through curb cuts or level spreaders to QPA.	☐	☐	☐	☐
Measures are employed at discharge point to prevent erosion and promote sheet flow.	☐	☐	☐	☐
The flow path through the QPA complies with the setback requirements for structural infiltration BMPs.	☐	☐	☐	☐
Rooftop runoff draining to QPA from LUHPPLs does not commingle with runoff from any paved surface or areas that may generate higher pollutant loads	☐	☐	☐	☐
Inspection and maintenance of the QPA is included in the site Operation and Maintenance Plan (Minimum Standard 11).	☐	☐	☐	☐
The QPA is owned or controlled by the property owner	☐	☐	☐	☐
There is no history of groundwater seepage and / or basement flooding on the property	☐	☐	☐	☐

A.1.5 Best Management Practices

Provide detailed information for all structural stormwater best management practices (BMPs) to be implemented. *Note: If a BMP cannot meet the required design criteria in Manual Chapters Five, Six, and Seven, a different BMP should be considered*.

Fill in the following table to document which proposed practices meet which requirement(s). Number each BMP and label them accordingly on the site map:

BMP No.	**Type of BMP**	**Check the function provided by the BMP**				
		Pretreatment	Re_v	WQ_v	CP_v	Q_p
1	Sediment Forebay	✔		✔		
2	Bioretention Area			✔		✔

In addition, for all structural components of stormwater system (e.g., storm drains, open channels, swales, stormwater BMPs, etc.) provide the following, if applicable:

☑ Hydrologic and hydraulic analysis, including:

- Study design/analysis points. The existing and proposed condition analyses need to compare the same overall area; thus, common study points are needed for both existing and proposed conditions.

- Existing condition analysis for drainage area boundaries, curve numbers, times of concentration, runoff rates, volumes, velocities, and water surface elevations showing methodologies used and supporting calculations.
- Proposed condition analysis for drainage area boundaries, curve numbers, times of concentration, runoff rates, volumes, velocities, water surface elevations, and routing showing the methodologies used and supporting calculations.
- Downstream Analysis, where required (see Manual Section 3.3.6).
- Final sizing calculations for structural stormwater BMPs including, contributing drainage area, storage, and outlet configuration.
- Stage-discharge or outlet rating curves and inflow and outflow hydrographs for storage facilities (e.g., detention, retention, or infiltration facilities).
- Dam breach analysis, where necessary, for earthen embankments over six (6) feet in height, or a capacity of 15 acre-feet or more, and that is a significant or high hazard dam.

☑ Drainage Area Maps prepared in accordance with DEM's *Guidance for Preparation of Drainage Area Maps* (included in Appendix K).

☑ Representative cross-section and profile drawings, notes and details of structural stormwater management practices and conveyances (i.e., storm drains, open channels, swales, etc.), which include:

- Locations, cross sections, and profiles of all streams and drainage swales and their method of stabilization.
- Existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.).
- Design water surface elevations.
- Structural details of outlet structures, embankments, spillways, stilling basins, grade control structures, conveyance channels, etc.
- Logs of borings and/or test pit investigations along with supporting soils/geotechnical report.

☑ Planting plans for structural stormwater BMPs, including:

- Species, size, planting methods, and maintenance requirements of proposed planting.

☑ Structural calculations, where necessary.

☑ Applicable construction specifications.

☑ Identification of all anticipated applicable local and State permits.

☑ Identification of all anticipated legal agreements related to stormwater (e.g., off-site easements, deed restrictions, and covenants).

1.0 Project Description

The purpose of this report is to specify a "Storm Water Management System" and a "Soil Erosion and Sediment Control Plan" to be implemented in the construction and maintenance of the proposed expansion at 2050 Plainfield Pike.

The site has an area of 1.39± acres and is located on Assessor's Plat 36/2 Lot 117 in Cranston, Rhode Island. The site is located off of Plainfield Pike and Sailor Way.

The proposed development will include a new 3,500 sf stone storage area for vehicles waiting to be maintained. The existing building is serviced by public water and sewer.

The stormwater quality will be improved by utilizing Best Management Practices (BMPs) as established by the RISDISM for the treatment of storm water runoff from the proposed development. BMPs will consist of a sediment forebay and bioretention area. The system has been designed to meet the RIDEM Stormwater Design and Installations Standards Manual December 2010.

2.0 Site Conditions

2.1 SOILS

There are the following soil types within the analyzed area of the Site as mapped by the NRCS USDA Soil Conservation service:

Soil Symbol	Description	Hydrologic Group
LgC	Lippitt gravelly sandy loam, very rocky, 3 to 15 percent slopes	C
StA	Sutton fine sandy loam, 0 to 3 percent slopes	B

The C-Series wetland area is mapped has LgC and StA. For the purpose of the HydroCAD analysis the wetland area has been assumed as Hydrologic group D soil.

2.2 EXISTING SITE CONDITIONS

The existing site is developed with an existing building and parking area. The southern portion of the site, which is the location of the proposed expansion, is wooded and contains a forested wetland area. Stormwater runoff, within the area to be developed, flows from north to south to the C-Series wetland. The C-Series wetland flows from west to east to an existing 48" culvert.

2.3 POST SITE CONDITIONS

Ground cover within the limit of work will consist of a stone storage area and grass/landscape areas. The proposed stone storage area will be lined and will include a sub-drain to direct stormwater runoff to a sediment forebay and bio-retention area. The bio-retention area will overflow towards the existing 48" culvert.

The proposed drainage analysis uses stormwater management systems to control and treat runoff from the proposed development. The following BMP is used on site and has been designed to include the following elements:

- Bio Retention Areas
    - Equipped with sediment forebay for pretreatment
    - 1.0' of bioretention soil under rain garden for stormwater filtration
    - Stores 75% of WQv
    - Maximum 9" of Ponding
    - Safely convey the 100 year storm.
    - Underdrain collects treated stormwater

The above elements will used to meet the Rhode Island Stormwater Design and Installation Standards Manual.

The primary goal of increasing water quality treatment is accomplished by providing water quality BMPs. By maintaining post development stormwater flow rates to a level no greater than the pre development rate, the second goal of the proposed drainage system is achieved. Any potential impacts from the proposed development on the abutting properties/wetlands etc has been mitigated.

3.0 Minimum Standards

The site has been designed to meet the minimum standards as outlined in the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM) dated December 2010. The following sections outline how the site meets and exceeds the minimum required standards.

3.1 Minimum Standard 1: LID Site Planning and Design Strategies

See Section 11.5 for "Appendix A: Stormwater Management Checklist" from the RISDISM

3.2 Minimum Standard 2: Groundwater Recharge

The site has a high water table and recharge is infeasible. For this reason groundwater recharge is not provided for in the drainage design.

3.3 Minimum Standard 3: Water Quality

All stormwater is treated through an approved BMP before being discharged. This site has been designed to use a bioretention area to treat stormwater before being discharged toward the wetland area onsite. See bio retention design sheets for water quality requirements. There are no pollutant-specific requirements and/or pollutant removal efficiencies applicable to the site as the result of SAMP, TMDL, or other watershed-specific requirements.

Although it is not required to treat existing impervious areas for water quality, the bioretention area was conservatively sized to provide 50% water quality treatment for the existing impervious area from the contributing watershed.

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Bio Retention Calculations

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Engineers • Planners • Surveyors

Bioretention Sizing

Name of Bioretention: A

Bioretention Parameters		
At,Total Area to Bioretention	0.378	(Acres)
Impervious Area To Bioretention	0.227	(Acres)
d_f, Filter Bed Depth	1.00	(feet)
k, Coefficient of Permeability	1.0	(ft/day)
h_f, Average Height of Water	0.38	(ft)
t_f, Design Filter Bed Drain Time	2.00	(days)
Ponding Depth	9	(in)
Mulch Depth	3	(in)

Water Quality Calculations

WQ_v= 1inch x Impervious Area

WQ_v= 824 (Cubic Feet)

Minimum Size of Bioretention Filter Area

$A_f=(WQ_v)x(d_f)/[(k)x(h_f+d_f)(t_f)]$

Required Af= 300 (Square Feet) Where A_f is the required filter bed area

Provided Af= 332 (Square Feet)

Bioretention Pre Treatment

Type of Pre Treatment: Sediment Forebay

As=5,750*Q Q=%WQv/86,400 %WQv=25%

Required As= 14 (Square Feet), where As is the required forebay Area

Provided As= 65 (Square Feet)

25% of Water Quality Volume must be provided in Forebay

Required Volume= 206 (Cubic Feet)

Provided Volume= 211 (Cubic Feet)

Required Water Quality Volume

75% of the WQv must be held within system (including forebay)

Required WQ_v 618 (Cubic Feet)

Volume of Mulch	27 (Cubic Feet)
Volume of Forebay	211 (Cubic Feet)
Volume of Ponding	327 (Cubic Feet)
Volume of Voids in Filter Bed	110 (Cubic Feet)
Total	**675 (Cubic Feet)**

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3.4 Minimum Standard 4: Conveyance and Natural Channel Protection

Drainage Network Design Parameters:

A. PIPES

- No drainage pipes are proposed for this development.

B. STRUCTURES

- No drainage structures are proposed for this development.

C. OPEN CHANNELS SYSTEMS (SWALES)

- No open channels are proposed for this development.

Channel Protection Volume:

Per section 3.3.4 of the RISDISM, Conveyance and Natural Channel Protection is not required because the overall impervious cover is less than one acre and the post development peak discharge from the facility is less than 2 cfs for the 1-year, 24 hour Type III design storm event.

3.5 Minimum Standard 5: Overbank Flood Protection & Downstream Analysis

3.5.1 Method of Analysis

USDA Soil Conservation Service Method as defined by Technical Release No. 20 (TR-20) determines Stormwater runoff rate and volume. Type III rainfall distribution is utilized. Time of concentration is determined using Technical Release No 55 (TR-55) methodology, through the computer program *HydroCAD ver. 9.0* by Applied Microcomputer Systems.

Bioretention Soil has been modeled in HydroCAD with a 2.41 inches/hr infiltration rate per Section 5.5.4 of the Stormwater Regulations. The bioretention area is proposed to be lined so infiltration has not been modeled in the design. An underdrain will pick up the filtered stormwater and discharge to daylight.

The drainage system has been designed to mitigate all stormwater flows for the 10 and 100 year storm events. The overflow outlet from the bioretention area has been sized to handle the 100 year storm event.

3.5.2 Design Storm

Analysis of 1-year, 10-year, 25-year, and 100-year frequency storms are included. The following 24-hour rainfall intensities are obtained from the Rhode Island Stormwater Design and Installation Standards Manual December 2010, Table 3-1 for Providence County.

1 year =	2.7 inches
10 year =	4.9 inches
25 year =	6.1 inches
100 year=	8.7 inches

3.5.3 Design Point Breakdown

The site is analyzed as one watershed area. In the pre development stage there are two subcatchments. In the post development stage there are three subcatchments. Each watershed will demonstrate zero increase of runoff due to the proposed development. A description of each watershed and associated subcatchments are summarized as follows:

<u>Design Point #1:</u>

Watershed #1 flows to Design Point- 1 (DP-1). This watershed consists of the portion of the site being developed and offsite area which flow to the existing 48” culvert. The design point is the 48” culvert.

In pre development conditions there are two watersheds to Design Point. Pre-1 contains the offsite area which flows to the existing 48” culvert. Pre-1 consists of a combination of existing impervious areas, wooded areas, grassed areas and wetlands. Stormwater reaches DP-1 by overland flow and existing drainage pipe discharges. A Tc value of 10.5 minutes was used.

Pre-2 contains the area of the proposed development. Stormwater reaches DP-1 by overland flow. Pre-2 is predominately impervious. A Tc value of 6 minutes was used.

In post development conditions there are three sub watersheds:

Post-1 contains the offsite area which flows to the existing 48" culvert. Post-1 consists of a combination of existing impervious areas, wooded areas, grassed areas and wetlands. Stormwater reaches DP-1 by overland flow and existing drainage pipe discharges. A Tc value of 10.5 minutes was used.

Post-2 contains the onsite area which bypasses the proposed bioretention area. Post-2 is predominantly impervious. Stormwater reaches DP-1 by overland flow. A Tc value of 6 minutes was used.

Post-3 contains onsite area and the proposed stone storage area which flow to the proposed bioretention area. Post-3 is predominantly impervious. The stone storage area, while pervious in nature has been modeled as impervious area to be conservative. Stormwater is collected in an underdrain system below the stone storage area and is routed through the proposed sediment forebay and bioretention area. Overflow from the bioretention area is directed towards the DP-1.

Below is a summary of the hydrologic parameters for the pre and post development sub-areas in Design Point-1.

	Area (acres)	CN	Tc (min)
Pre-1	7.539	79	10.5
Pre-2	0.602	93	6.0
Post-1	7.539	79	10.5
Post-2	0.224	97	6.0
Post-3	0.378	95	6.0

3.5.4 Q_P BMP Calculations

No channel protection BMPs are proposed for this development. The bioretention overflow has been sized to safely convey the 100-Year Storm event. Per the HydroCAD model, for the 100-Year design storm the velocity over the bioretention overflow is less than 3 ft/s (1.07 ft/s) thus no erosion will take place on the embankment or downstream.

Outlet Protection

No drainage pipe discharges are proposed for the development.

3.5.5 Overbank Flood Protection Conclusion

The table below presents a summary of the pre development flows vs. the mitigated post development flows. The table shows a decrease in the rate of runoff for all storms included in the analysis, with the exception of an insignificant increase for the 100-Year design storm.

Pre Development Flows vs. Post Development Flows Mitigated

Watershed #1: (DP-1)

Conditions	1-Year	10-Year	25-Year	100-Year
Pre Dev Summation	8.10 cfs	22.56 cfs	31.00 cfs	49.57 cfs
Post Dev Summation	7.53 cfs	21.68 cfs	30.98 cfs	49.75 cfs
Net Change	**-0.57 cfs**	**-0.88 cfs**	**-0.02 cfs**	**+0.18 cfs**

(cfs = cubic feet per second)

For the 100-Year design storm there is a 0.17 cfs increase in stormwater flow rate from pre to post development conditions. This is a 0.4% increase over pre development conditions and considered negligible. The peak elevation within the depression preceding the existing 48" culvert will increase by 0.01 feet for the 100-Year design storm. This increase in peak elevation is also considered negligible.

3.5.6 Downstream Analysis

A downstream analysis is required under the following conditions:

Area of Disturbance (Acres)	Impervious Cover (%)
>5 to 10	>75
>10 to 25	>50
>25 to 50	>25
>50	All Projects

The proposed project disturbs 0.127 acres and is 0.081 acres of impervious (stone storage area has been assumed to be impervious to be conservative). This is approximately 64% impervious cover. A downstream analysis is not required.

3.6 Minimum Standard 6: Redevelopment and Infill Projects.

This site is not a redevelopment project since less than 10,000 SF of existing impervious area is proposed to be disturbed.

3.7 Minimum Standard 7: Pollution Prevention

A Stormwater Pollution Prevention Plan (SWPPP) for this development can be found under a separate document. See the Stormwater Pollution Prevention Plan for the development prepared by DiPrete Engineering. The SWPPP contains information for construction pollution prevention. For post construction pollution prevention see the Operations and Maintenance (O&M) document prepared for this development by DiPrete Engineering.

3.8 Minimum Standard 8: Land Uses with High Potential Pollutant Loads (LUHPPLs)

The proposed development is for a stone storage area for storage of vehicles waiting to be maintained (East Side Collision Center). The site is considered a LUHHPL and runoff will be treated within a lined bioretention area.

3.9 Minimum Standard 9: Illicit Discharges

There are no proposed Illicit Discharges on site. The existing site is already serviced by public water and sewer.

3.10 Minimum Standard 10: Construction Erosion and Sedimentation Control

See the SWPPP for this development prepared by DiPrete Engineering.

3.11 Minimum Standard 11: Stormwater Management System Operation and Maintenance

See the O&M for this development prepared by DiPrete Engineering.

Appendix A

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A3.4.1 Channel Protection (CP_v) HydroCAD 1-Year Storm Analysis

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Summary for Subcatchment Pst-1: Offsite Area (Cadence)

Runoff = 7.07 cfs @ 12.16 hrs, Volume= 0.612 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
1.011	98	Roofs, HSG B
1.755	98	Paved parking, HSG B
1.099	61	>75% Grass cover, Good, HSG B
1.836	74	>75% Grass cover, Good, HSG C
0.110	80	>75% Grass cover, Good, HSG D
0.768	55	Woods, Good, HSG B
0.960	70	Woods, Good, HSG C
7.539	79	Weighted Average
4.773		63.31% Pervious Area
2.766		36.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	45	0.0520	0.10		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.30"
0.9	203	0.0610	3.98		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
0.3	80	0.0450	4.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.7	320	0.0370	3.10		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
10.5	648	Total			

Summary for Subcatchment Pst-2: Existing Site

Runoff = 0.56 cfs @ 12.09 hrs, Volume= 0.044 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-Year Rainfall=2.70"

	Area (ac)	CN	Description
*	0.131	98	Existing Pavement
*	0.084	98	Existing Roof
*	0.009	74	Existing Grassed Area
	0.224	97	Weighted Average
	0.009		4.02% Pervious Area
	0.215		95.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Summary for Subcatchment Pst-3: Proposed Conditions

Runoff = 0.89 cfs @ 12.09 hrs, Volume= 0.068 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-Year Rainfall=2.70"

	Area (ac)	CN	Description
*	0.227	98	Existing Pavement
*	0.024	98	Existing Roof
*	0.046	74	Sediment FB/Bioretention Area
*	0.081	98	Stone Storage Area
	0.378	95	Weighted Average
	0.046		12.17% Pervious Area
	0.332		87.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Summary for Reach DP-1: Design Point

Inflow Area = 8.141 ac, 40.70% Impervious, Inflow Depth = 1.06" for 1-Year event
Inflow = 7.53 cfs @ 12.15 hrs, Volume= 0.719 af
Outflow = 7.53 cfs @ 12.15 hrs, Volume= 0.719 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond Bio-A: Bio - A

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 2.01" for 1-Year event
Inflow = 0.31 cfs @ 12.37 hrs, Volume= 0.063 af
Outflow = 0.31 cfs @ 12.45 hrs, Volume= 0.063 af, Atten= 1%, Lag= 4.9 min
Primary = 0.31 cfs @ 12.45 hrs, Volume= 0.063 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 292.54' @ 12.45 hrs Surf.Area= 887 sf Storage= 539 cf

Plug-Flow detention time= 92.6 min calculated for 0.063 af (100% of inflow)
Center-of-Mass det. time= 91.5 min (962.1 - 870.6)

Volume	Invert	Avail.Storage	Storage Description
#1	291.75'	475 cf	**Ponding Area (Prismatic)** Listed below (Recalc)
#2	290.00'	192 cf	**Mulch, Bio-media and Pea Gravel (Prismatic)** Listed below (Recalc) 581 cf Overall x 33.0% Voids
		666 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
291.75	332	0	0
292.50	540	327	327
292.75	642	148	475

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.00	332	0	0
291.75	332	581	581

Device	Routing	Invert	Outlet Devices
#1	Primary	292.50'	**14.0' long x 3.0' breadth Overflow** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	290.00'	**2.410 in/hr Subdrain over Surface area**

Primary OutFlow Max=0.30 cfs @ 12.45 hrs HW=292.54' (Free Discharge)
└**1=Overflow** (Weir Controls 0.25 cfs @ 0.47 fps)
└**2=Subdrain** (Exfiltration Controls 0.05 cfs)

Summary for Pond Culvert: EX 48" Culvert

Inflow Area = 8.141 ac, 40.70% Impervious, Inflow Depth = 1.06" for 1-Year event
Inflow = 7.54 cfs @ 12.15 hrs, Volume= 0.719 af
Outflow = 7.53 cfs @ 12.15 hrs, Volume= 0.719 af, Atten= 0%, Lag= 0.0 min
Primary = 7.53 cfs @ 12.15 hrs, Volume= 0.719 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 285.61' @ 12.15 hrs Surf.Area= 0.000 ac Storage= 0.000 af

Plug-Flow detention time= 0.3 min calculated for 0.718 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (863.2 - 863.2)

Volume	Invert	Avail.Storage	Storage Description
#1	284.00'	0.019 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
284.00	0.000	0.000	0.000
285.00	0.000	0.000	0.000
286.00	0.000	0.000	0.000
287.00	0.001	0.001	0.001
288.00	0.002	0.002	0.003
289.00	0.007	0.004	0.007
290.00	0.017	0.012	0.019

Device	Routing	Invert	Outlet Devices
#1	Primary	284.66'	**48.0" Round Culvert**

L= 136.0' CPP, square edge headwall, Ke= 0.500
Outlet Invert= 283.76' S= 0.0066 '/' Cc= 0.900
n= 0.011 Concrete pipe, straight & clean

Primary OutFlow Max=7.48 cfs @ 12.15 hrs HW=285.61' (Free Discharge)
└**1=Culvert** (Barrel Controls 7.48 cfs @ 4.96 fps)

Summary for Pond FB: Sediment Forebay

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 2.16" for 1-Year event
Inflow = 0.31 cfs @ 12.36 hrs, Volume= 0.068 af
Outflow = 0.31 cfs @ 12.37 hrs, Volume= 0.063 af, Atten= 0%, Lag= 0.4 min
Primary = 0.31 cfs @ 12.37 hrs, Volume= 0.063 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 292.57' @ 12.37 hrs Surf.Area= 149 sf Storage= 217 cf

Plug-Flow detention time= 68.7 min calculated for 0.063 af (93% of inflow)
Center-of-Mass det. time= 21.3 min (870.6 - 849.2)

Volume	Invert	Avail.Storage	Storage Description
#1	290.50'	286 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.50	65	0	0
291.00	83	37	37
292.00	123	103	140
292.50	146	67	207
293.00	170	79	286

Device	Routing	Invert	Outlet Devices
#1	Primary	292.50'	**7.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.31 cfs @ 12.37 hrs HW=292.57' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.31 cfs @ 0.66 fps)

Summary for Pond ST: Stone Storage Area

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 2.16" for 1-Year event
Inflow = 0.89 cfs @ 12.09 hrs, Volume= 0.068 af
Outflow = 0.31 cfs @ 12.36 hrs, Volume= 0.068 af, Atten= 65%, Lag= 16.5 min
Primary = 0.31 cfs @ 12.36 hrs, Volume= 0.068 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2

Peak Elev= 291.87' @ 12.36 hrs Surf.Area= 3,512 sf Storage= 838 cf

Plug-Flow detention time= 61.7 min calculated for 0.068 af (100% of inflow)
Center-of-Mass det. time= 62.9 min (849.2 - 786.4)

Volume	Invert	Avail.Storage	Storage Description
#1	291.15'	1,773 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 5,373 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
291.15	3,512	0	0
292.68	3,512	5,373	5,373

Device	Routing	Invert	Outlet Devices
#1	Primary	291.15'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	292.43'	**36.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.31 cfs @ 12.36 hrs HW=291.87' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.31 cfs @ 3.59 fps)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

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A3.5.4.1 HydroCAD Node Diagram

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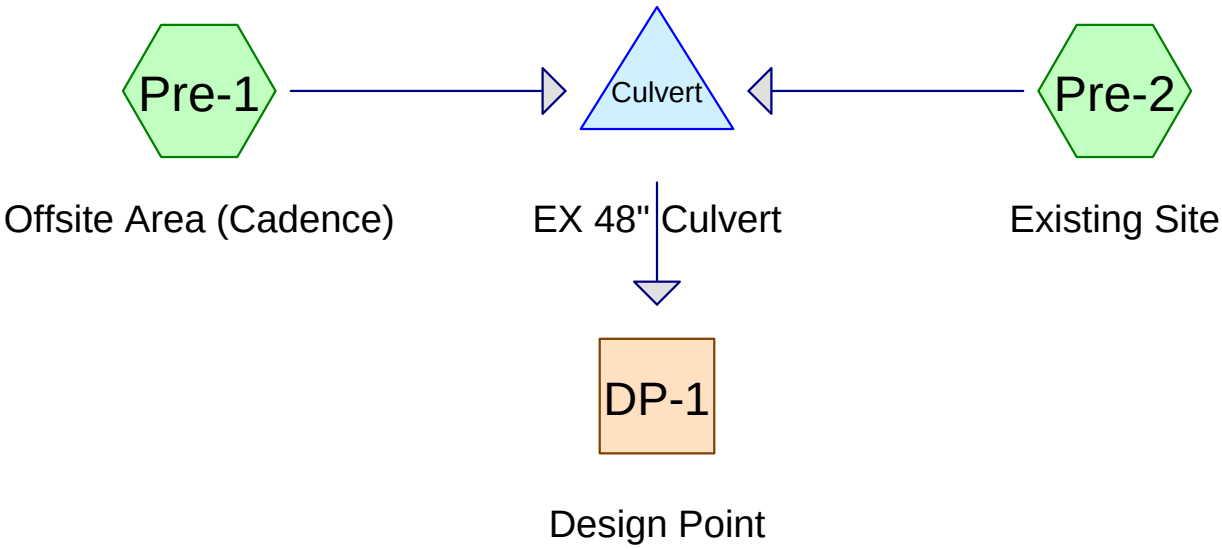
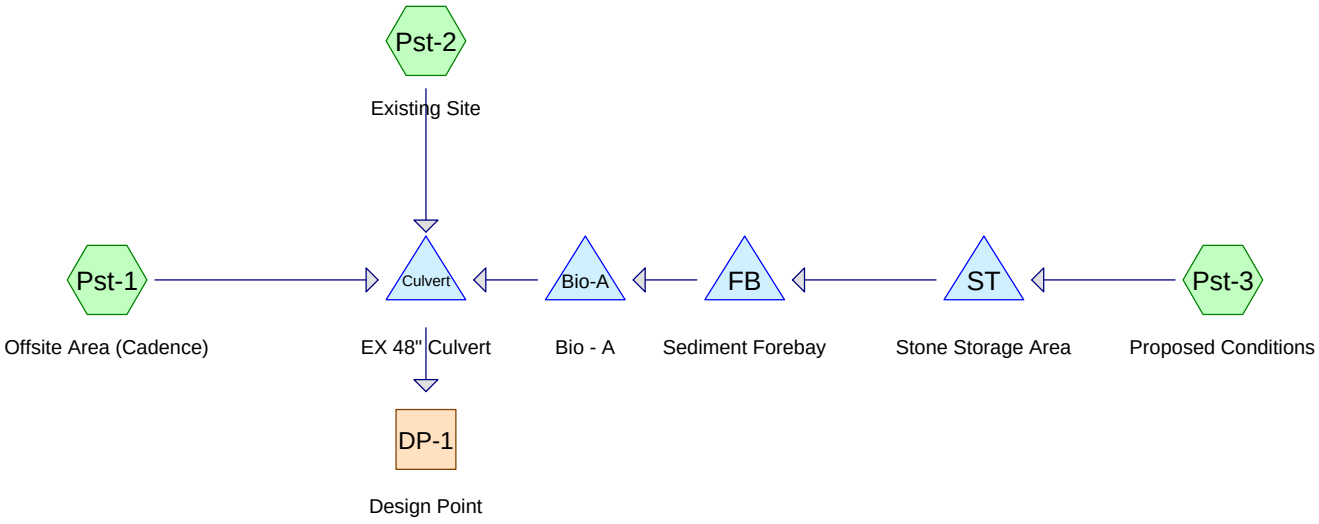


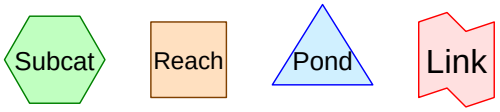
Subcat Reach Pond Link

Drainage Diagram for 1215-001-ALLS-EHCD-INHS-20121025
Prepared by DiPrete Engineering, Printed 11/13/2012
HydroCAD® 9.00 s/n 02288 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.768	55	Woods, Good, HSG B (Pre-1)
1.099	61	>75% Grass cover, Good, HSG B (Pre-1)
1.012	70	Woods, Good, HSG C (Pre-1, Pre-2)
1.836	74	>75% Grass cover, Good, HSG C (Pre-1)
0.009	74	Existing Grassed Area (Pre-2)
0.071	77	Woods, Good, HSG D (Pre-2)
0.110	80	>75% Grass cover, Good, HSG D (Pre-1)
0.298	98	Existing Pavement (Pre-2)
0.172	98	Existing Roof (Pre-2)
1.755	98	Paved parking, HSG B (Pre-1)
1.011	98	Roofs, HSG B (Pre-1)





Drainage Diagram for 1215-001-ALLS-PHCD-INHS-20121101
Prepared by DiPrete Engineering, Printed 11/13/2012
HydroCAD® 9.00 s/n 02288 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.768	55	Woods, Good, HSG B (Pst-1)
1.099	61	>75% Grass cover, Good, HSG B (Pst-1)
0.960	70	Woods, Good, HSG C (Pst-1)
1.836	74	>75% Grass cover, Good, HSG C (Pst-1)
0.009	74	Existing Grassed Area (Pst-2)
0.046	74	Sediment FB/Bioretention Area (Pst-3)
0.110	80	>75% Grass cover, Good, HSG D (Pst-1)
0.358	98	Existing Pavement (Pst-2, Pst-3)
0.108	98	Existing Roof (Pst-2, Pst-3)
1.755	98	Paved parking, HSG B (Pst-1)
1.011	98	Roofs, HSG B (Pst-1)
0.081	98	Stone Storage Area (Pst-3)

A3.5.4.2 HydroCAD 10-Year Storm Analysis

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Summary for Subcatchment Pre-1: Offsite Area (Cadence)

Runoff = 20.46 cfs @ 12.15 hrs, Volume= 1.706 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
1.011	98	Roofs, HSG B
1.755	98	Paved parking, HSG B
1.099	61	>75% Grass cover, Good, HSG B
1.836	74	>75% Grass cover, Good, HSG C
0.110	80	>75% Grass cover, Good, HSG D
0.768	55	Woods, Good, HSG B
0.960	70	Woods, Good, HSG C
7.539	79	Weighted Average
4.773		63.31% Pervious Area
2.766		36.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	45	0.0520	0.10		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.30"
0.9	203	0.0610	3.98		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
0.3	80	0.0450	4.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.7	320	0.0370	3.10		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
10.5	648	Total			

Summary for Subcatchment Pre-2: Existing Site

Runoff = 2.66 cfs @ 12.09 hrs, Volume= 0.206 af, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
*	0.298	98	Existing Pavement
*	0.172	98	Existing Roof
	0.052	70	Woods, Good, HSG C
	0.071	77	Woods, Good, HSG D
*	0.009	74	Existing Grassed Area
	0.602	93	Weighted Average
	0.132		21.93% Pervious Area
	0.470		78.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Summary for Reach DP-1: Design Point

Inflow Area = 8.141 ac, 39.75% Impervious, Inflow Depth = 2.82" for 10-Year event
Inflow = 22.56 cfs @ 12.14 hrs, Volume= 1.911 af
Outflow = 22.56 cfs @ 12.14 hrs, Volume= 1.911 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond Culvert: EX 48" Culvert

Inflow Area = 8.141 ac, 39.75% Impervious, Inflow Depth = 2.82" for 10-Year event
Inflow = 22.58 cfs @ 12.14 hrs, Volume= 1.912 af
Outflow = 22.56 cfs @ 12.14 hrs, Volume= 1.911 af, Atten= 0%, Lag= 0.0 min
Primary = 22.56 cfs @ 12.14 hrs, Volume= 1.911 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 286.42' @ 12.14 hrs Surf.Area= 0.001 ac Storage= 0.001 af

Plug-Flow detention time= 0.5 min calculated for 1.911 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (824.1 - 824.1)

Volume	Invert	Avail.Storage	Storage Description
#1	284.00'	0.019 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
284.00	0.000	0.000	0.000
285.00	0.000	0.000	0.000
286.00	0.000	0.000	0.000
287.00	0.001	0.001	0.001
288.00	0.002	0.002	0.003
289.00	0.007	0.004	0.007
290.00	0.017	0.012	0.019

Device	Routing	Invert	Outlet Devices
#1	Primary	284.66'	**48.0" Round Culvert** L= 136.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 283.76' S= 0.0066 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean

Primary OutFlow Max=22.34 cfs @ 12.14 hrs HW=286.41' (Free Discharge)
1=Culvert (Barrel Controls 22.34 cfs @ 6.22 fps)

Summary for Subcatchment Pst-1: Offsite Area (Cadence)

Runoff = 20.46 cfs @ 12.15 hrs, Volume= 1.706 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
1.011	98	Roofs, HSG B
1.755	98	Paved parking, HSG B
1.099	61	>75% Grass cover, Good, HSG B
1.836	74	>75% Grass cover, Good, HSG C
0.110	80	>75% Grass cover, Good, HSG D
0.768	55	Woods, Good, HSG B
0.960	70	Woods, Good, HSG C
7.539	79	Weighted Average
4.773		63.31% Pervious Area
2.766		36.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	45	0.0520	0.10		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.30"
0.9	203	0.0610	3.98		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
0.3	80	0.0450	4.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.7	320	0.0370	3.10		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
10.5	648	Total			

Summary for Subcatchment Pst-2: Existing Site

Runoff = 1.04 cfs @ 12.09 hrs, Volume= 0.085 af, Depth= 4.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
*	0.131	98	Existing Pavement
*	0.084	98	Existing Roof
*	0.009	74	Existing Grassed Area
	0.224	97	Weighted Average
	0.009		4.02% Pervious Area
	0.215		95.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Summary for Subcatchment Pst-3: Proposed Conditions

Runoff = 1.72 cfs @ 12.09 hrs, Volume= 0.136 af, Depth= 4.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
*	0.227	98	Existing Pavement
*	0.024	98	Existing Roof
*	0.046	74	Sediment FB/Bioretention Area
*	0.081	98	Stone Storage Area
	0.378	95	Weighted Average
	0.046		12.17% Pervious Area
	0.332		87.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Summary for Reach DP-1: Design Point

Inflow Area = 8.141 ac, 40.70% Impervious, Inflow Depth = 2.83" for 10-Year event
Inflow = 21.68 cfs @ 12.15 hrs, Volume= 1.921 af
Outflow = 21.68 cfs @ 12.15 hrs, Volume= 1.921 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond Bio-A: Bio - A

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 4.18" for 10-Year event
Inflow = 1.04 cfs @ 12.21 hrs, Volume= 0.132 af
Outflow = 0.90 cfs @ 12.23 hrs, Volume= 0.132 af, Atten= 13%, Lag= 0.9 min
Primary = 0.90 cfs @ 12.23 hrs, Volume= 0.132 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 292.59' @ 12.23 hrs Surf.Area= 907 sf Storage= 566 cf

Plug-Flow detention time= 66.1 min calculated for 0.132 af (100% of inflow)
Center-of-Mass det. time= 65.7 min (903.0 - 837.3)

Volume	Invert	Avail.Storage	Storage Description
#1	291.75'	475 cf	**Ponding Area (Prismatic)** Listed below (Recalc)
#2	290.00'	192 cf	**Mulch, Bio-media and Pea Gravel (Prismatic)** Listed below (Recalc) 581 cf Overall x 33.0% Voids
		666 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
291.75	332	0	0
292.50	540	327	327
292.75	642	148	475

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.00	332	0	0
291.75	332	581	581

Device	Routing	Invert	Outlet Devices
#1	Primary	292.50'	**14.0' long x 3.0' breadth Overflow** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	290.00'	**2.410 in/hr Subdrain over Surface area**

Primary OutFlow Max=0.88 cfs @ 12.23 hrs HW=292.58' (Free Discharge)
└**1=Overflow** (Weir Controls 0.83 cfs @ 0.71 fps)
└**2=Subdrain** (Exfiltration Controls 0.05 cfs)

Summary for Pond Culvert: EX 48" Culvert

Inflow Area = 8.141 ac, 40.70% Impervious, Inflow Depth = 2.83" for 10-Year event
Inflow = 21.69 cfs @ 12.15 hrs, Volume= 1.923 af
Outflow = 21.68 cfs @ 12.15 hrs, Volume= 1.921 af, Atten= 0%, Lag= 0.0 min
Primary = 21.68 cfs @ 12.15 hrs, Volume= 1.921 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 286.38' @ 12.15 hrs Surf.Area= 0.001 ac Storage= 0.000 af

Plug-Flow detention time= 0.5 min calculated for 1.920 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (831.4 - 831.3)

Volume	Invert	Avail.Storage	Storage Description
#1	284.00'	0.019 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
284.00	0.000	0.000	0.000
285.00	0.000	0.000	0.000
286.00	0.000	0.000	0.000
287.00	0.001	0.001	0.001
288.00	0.002	0.002	0.003
289.00	0.007	0.004	0.007
290.00	0.017	0.012	0.019

Device	Routing	Invert	Outlet Devices
#1	Primary	284.66'	**48.0" Round Culvert**

L= 136.0' CPP, square edge headwall, Ke= 0.500
Outlet Invert= 283.76' S= 0.0066 '/' Cc= 0.900
n= 0.011 Concrete pipe, straight & clean

Primary OutFlow Max=21.64 cfs @ 12.15 hrs HW=286.38' (Free Discharge)
└**1=Culvert** (Barrel Controls 21.64 cfs @ 6.18 fps)

Summary for Pond FB: Sediment Forebay

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 4.33" for 10-Year event
Inflow = 1.07 cfs @ 12.21 hrs, Volume= 0.136 af
Outflow = 1.04 cfs @ 12.21 hrs, Volume= 0.132 af, Atten= 3%, Lag= 0.1 min
Primary = 1.04 cfs @ 12.21 hrs, Volume= 0.132 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 292.65' @ 12.22 hrs Surf.Area= 153 sf Storage= 230 cf

Plug-Flow detention time= 40.7 min calculated for 0.132 af (97% of inflow)
Center-of-Mass det. time= 14.9 min (837.3 - 822.4)

Volume	Invert	Avail.Storage	Storage Description
#1	290.50'	286 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.50	65	0	0
291.00	83	37	37
292.00	123	103	140
292.50	146	67	207
293.00	170	79	286

Device	Routing	Invert	Outlet Devices
#1	Primary	292.50'	**7.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.96 cfs @ 12.21 hrs HW=292.64' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.96 cfs @ 0.96 fps)

Summary for Pond ST: Stone Storage Area

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 4.32" for 10-Year event
Inflow = 1.72 cfs @ 12.09 hrs, Volume= 0.136 af
Outflow = 1.07 cfs @ 12.21 hrs, Volume= 0.136 af, Atten= 38%, Lag= 7.6 min
Primary = 1.07 cfs @ 12.21 hrs, Volume= 0.136 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2

Peak Elev= 292.47' @ 12.22 hrs Surf.Area= 3,512 sf Storage= 1,530 cf

Plug-Flow detention time= 50.4 min calculated for 0.136 af (100% of inflow)
Center-of-Mass det. time= 53.6 min (822.4 - 768.8)

Volume	Invert	Avail.Storage	Storage Description
#1	291.15'	1,773 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 5,373 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
291.15	3,512	0	0
292.68	3,512	5,373	5,373

Device	Routing	Invert	Outlet Devices
#1	Primary	291.15'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	292.43'	**36.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.98 cfs @ 12.21 hrs HW=292.46' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.45 cfs @ 5.15 fps)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.53 cfs @ 0.48 fps)

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A3.5.4.3 HydroCAD 25-Year Storm Analysis

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Summary for Subcatchment Pre-1: Offsite Area (Cadence)

Runoff = 28.33 cfs @ 12.15 hrs, Volume= 2.368 af, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.10"

Area (ac)	CN	Description
1.011	98	Roofs, HSG B
1.755	98	Paved parking, HSG B
1.099	61	>75% Grass cover, Good, HSG B
1.836	74	>75% Grass cover, Good, HSG C
0.110	80	>75% Grass cover, Good, HSG D
0.768	55	Woods, Good, HSG B
0.960	70	Woods, Good, HSG C
7.539	79	Weighted Average
4.773		63.31% Pervious Area
2.766		36.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	45	0.0520	0.10		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.30"
0.9	203	0.0610	3.98		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
0.3	80	0.0450	4.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.7	320	0.0370	3.10		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
10.5	648	Total			

Summary for Subcatchment Pre-2: Existing Site

Runoff = 3.38 cfs @ 12.09 hrs, Volume= 0.265 af, Depth= 5.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.10"

	Area (ac)	CN	Description
*	0.298	98	Existing Pavement
*	0.172	98	Existing Roof
	0.052	70	Woods, Good, HSG C
	0.071	77	Woods, Good, HSG D
*	0.009	74	Existing Grassed Area
	0.602	93	Weighted Average
	0.132		21.93% Pervious Area
	0.470		78.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Summary for Reach DP-1: Design Point

Inflow Area = 8.141 ac, 39.75% Impervious, Inflow Depth = 3.88" for 25-Year event
Inflow = 31.00 cfs @ 12.14 hrs, Volume= 2.631 af
Outflow = 31.00 cfs @ 12.14 hrs, Volume= 2.631 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond Culvert: EX 48" Culvert

Inflow Area = 8.141 ac, 39.75% Impervious, Inflow Depth = 3.88" for 25-Year event
Inflow = 31.03 cfs @ 12.14 hrs, Volume= 2.633 af
Outflow = 31.00 cfs @ 12.14 hrs, Volume= 2.631 af, Atten= 0%, Lag= 0.0 min
Primary = 31.00 cfs @ 12.14 hrs, Volume= 2.631 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 286.79' @ 12.14 hrs Surf.Area= 0.001 ac Storage= 0.001 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (815.4 - 815.4)

Volume	Invert	Avail.Storage	Storage Description
#1	284.00'	0.019 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
284.00	0.000	0.000	0.000
285.00	0.000	0.000	0.000
286.00	0.000	0.000	0.000
287.00	0.001	0.001	0.001
288.00	0.002	0.002	0.003
289.00	0.007	0.004	0.007
290.00	0.017	0.012	0.019

Device	Routing	Invert	Outlet Devices
#1	Primary	284.66'	**48.0" Round Culvert** L= 136.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 283.76' S= 0.0066 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean

Primary OutFlow Max=30.65 cfs @ 12.14 hrs HW=286.77' (Free Discharge)
1=Culvert (Barrel Controls 30.65 cfs @ 6.62 fps)

Summary for Subcatchment Pst-1: Offsite Area (Cadence)

Runoff = 28.33 cfs @ 12.15 hrs, Volume= 2.368 af, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.10"

Area (ac)	CN	Description
1.011	98	Roofs, HSG B
1.755	98	Paved parking, HSG B
1.099	61	>75% Grass cover, Good, HSG B
1.836	74	>75% Grass cover, Good, HSG C
0.110	80	>75% Grass cover, Good, HSG D
0.768	55	Woods, Good, HSG B
0.960	70	Woods, Good, HSG C
7.539	79	Weighted Average
4.773		63.31% Pervious Area
2.766		36.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	45	0.0520	0.10		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.30"
0.9	203	0.0610	3.98		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
0.3	80	0.0450	4.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.7	320	0.0370	3.10		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
10.5	648	Total			

Summary for Subcatchment Pst-2: Existing Site

Runoff = 1.30 cfs @ 12.09 hrs, Volume= 0.107 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.10"

	Area (ac)	CN	Description
*	0.131	98	Existing Pavement
*	0.084	98	Existing Roof
*	0.009	74	Existing Grassed Area
	0.224	97	Weighted Average
	0.009		4.02% Pervious Area
	0.215		95.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Summary for Subcatchment Pst-3: Proposed Conditions

Runoff = 2.16 cfs @ 12.09 hrs, Volume= 0.174 af, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.10"

	Area (ac)	CN	Description
*	0.227	98	Existing Pavement
*	0.024	98	Existing Roof
*	0.046	74	Sediment FB/Bioretention Area
*	0.081	98	Stone Storage Area
	0.378	95	Weighted Average
	0.046		12.17% Pervious Area
	0.332		87.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Summary for Reach DP-1: Design Point

Inflow Area = 8.141 ac, 40.70% Impervious, Inflow Depth = 3.89" for 25-Year event
Inflow = 30.98 cfs @ 12.15 hrs, Volume= 2.642 af
Outflow = 30.98 cfs @ 12.15 hrs, Volume= 2.642 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond Bio-A: Bio - A

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 5.37" for 25-Year event
Inflow = 1.73 cfs @ 12.15 hrs, Volume= 0.169 af
Outflow = 1.68 cfs @ 12.16 hrs, Volume= 0.169 af, Atten= 3%, Lag= 0.6 min
Primary = 1.68 cfs @ 12.16 hrs, Volume= 0.169 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 292.63' @ 12.16 hrs Surf.Area= 925 sf Storage= 593 cf

Plug-Flow detention time= 58.7 min calculated for 0.169 af (100% of inflow)
Center-of-Mass det. time= 58.3 min (882.4 - 824.0)

Volume	Invert	Avail.Storage	Storage Description
#1	291.75'	475 cf	**Ponding Area (Prismatic)** Listed below (Recalc)
#2	290.00'	192 cf	**Mulch, Bio-media and Pea Gravel (Prismatic)** Listed below (Recalc) 581 cf Overall x 33.0% Voids
		666 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
291.75	332	0	0
292.50	540	327	327
292.75	642	148	475

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.00	332	0	0
291.75	332	581	581

Device	Routing	Invert	Outlet Devices
#1	Primary	292.50'	**14.0' long x 3.0' breadth Overflow** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	290.00'	**2.410 in/hr Subdrain over Surface area**

Primary OutFlow Max=1.62 cfs @ 12.16 hrs HW=292.63' (Free Discharge)
└**1=Overflow** (Weir Controls 1.57 cfs @ 0.87 fps)
└**2=Subdrain** (Exfiltration Controls 0.05 cfs)

Summary for Pond Culvert: EX 48" Culvert

Inflow Area = 8.141 ac, 40.70% Impervious, Inflow Depth = 3.90" for 25-Year event
Inflow = 31.01 cfs @ 12.15 hrs, Volume= 2.644 af
Outflow = 30.98 cfs @ 12.15 hrs, Volume= 2.642 af, Atten= 0%, Lag= 0.0 min
Primary = 30.98 cfs @ 12.15 hrs, Volume= 2.642 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 286.78' @ 12.15 hrs Surf.Area= 0.001 ac Storage= 0.001 af

Plug-Flow detention time= 0.6 min calculated for 2.640 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (821.4 - 821.4)

Volume	Invert	Avail.Storage	Storage Description
#1	284.00'	0.019 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
284.00	0.000	0.000	0.000
285.00	0.000	0.000	0.000
286.00	0.000	0.000	0.000
287.00	0.001	0.001	0.001
288.00	0.002	0.002	0.003
289.00	0.007	0.004	0.007
290.00	0.017	0.012	0.019

Device	Routing	Invert	Outlet Devices
#1	Primary	284.66'	**48.0" Round Culvert**

L= 136.0' CPP, square edge headwall, Ke= 0.500
Outlet Invert= 283.76' S= 0.0066 '/' Cc= 0.900
n= 0.011 Concrete pipe, straight & clean

Primary OutFlow Max=30.84 cfs @ 12.15 hrs HW=286.78' (Free Discharge)
└**1=Culvert** (Barrel Controls 30.84 cfs @ 6.63 fps)

Summary for Pond FB: Sediment Forebay

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 5.52" for 25-Year event
Inflow = 1.76 cfs @ 12.15 hrs, Volume= 0.174 af
Outflow = 1.73 cfs @ 12.15 hrs, Volume= 0.169 af, Atten= 2%, Lag= 0.1 min
Primary = 1.73 cfs @ 12.15 hrs, Volume= 0.169 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 292.71' @ 12.15 hrs Surf.Area= 156 sf Storage= 239 cf

Plug-Flow detention time= 32.2 min calculated for 0.169 af (97% of inflow)
Center-of-Mass det. time= 12.9 min (824.0 - 811.1)

Volume	Invert	Avail.Storage	Storage Description
#1	290.50'	286 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.50	65	0	0
291.00	83	37	37
292.00	123	103	140
292.50	146	67	207
293.00	170	79	286

Device	Routing	Invert	Outlet Devices
#1	Primary	292.50'	**7.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=1.71 cfs @ 12.15 hrs HW=292.71' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 1.71 cfs @ 1.16 fps)

Summary for Pond ST: Stone Storage Area

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 5.51" for 25-Year event
Inflow = 2.16 cfs @ 12.09 hrs, Volume= 0.174 af
Outflow = 1.76 cfs @ 12.15 hrs, Volume= 0.174 af, Atten= 19%, Lag= 3.5 min
Primary = 1.76 cfs @ 12.15 hrs, Volume= 0.174 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2

Peak Elev= 292.49' @ 12.14 hrs Surf.Area= 3,512 sf Storage= 1,549 cf

Plug-Flow detention time= 45.9 min calculated for 0.173 af (100% of inflow)
Center-of-Mass det. time= 47.9 min (811.1 - 763.2)

Volume	Invert	Avail.Storage	Storage Description
#1	291.15'	1,773 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 5,373 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
291.15	3,512	0	0
292.68	3,512	5,373	5,373

Device	Routing	Invert	Outlet Devices
#1	Primary	291.15'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	292.43'	**36.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=1.72 cfs @ 12.15 hrs HW=292.49' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.45 cfs @ 5.21 fps)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.26 cfs @ 0.63 fps)

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A3.5.4.4 HydroCAD 100-Year Storm Analysis

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Summary for Subcatchment Pre-1: Offsite Area (Cadence)

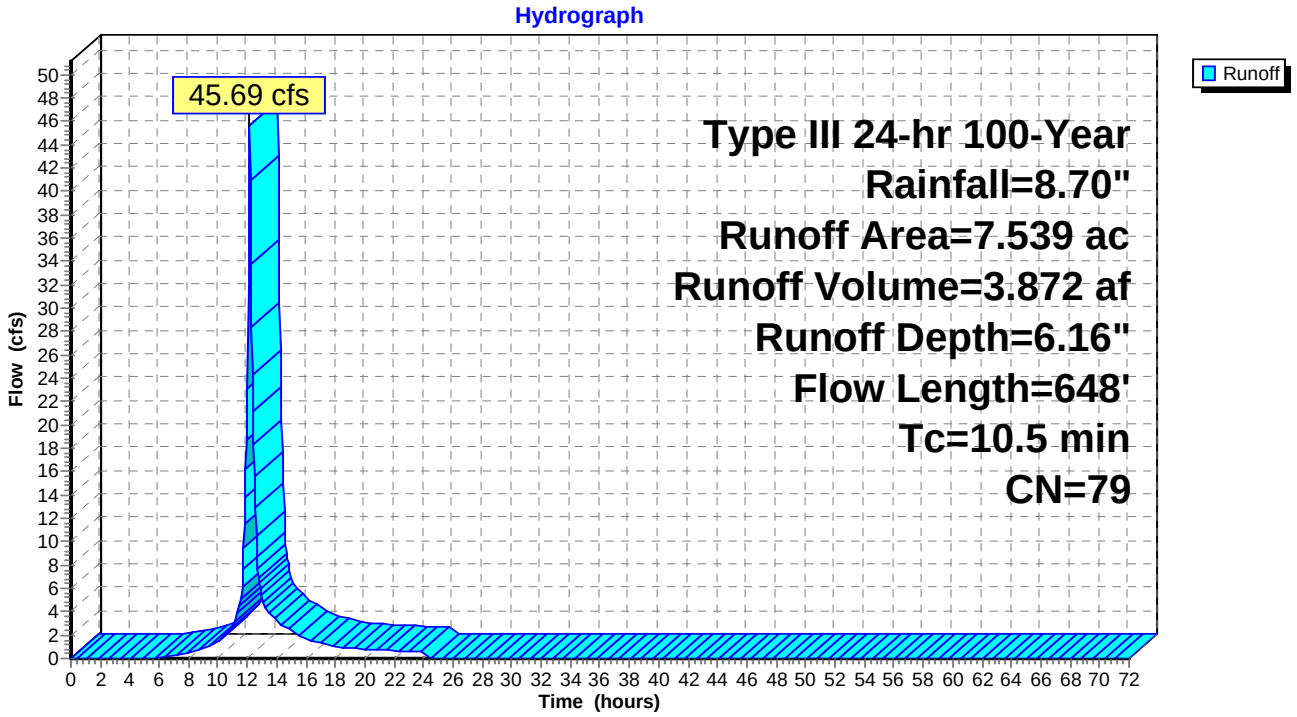
Runoff = 45.69 cfs @ 12.15 hrs, Volume= 3.872 af, Depth= 6.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
1.011	98	Roofs, HSG B
1.755	98	Paved parking, HSG B
1.099	61	>75% Grass cover, Good, HSG B
1.836	74	>75% Grass cover, Good, HSG C
0.110	80	>75% Grass cover, Good, HSG D
0.768	55	Woods, Good, HSG B
0.960	70	Woods, Good, HSG C
7.539	79	Weighted Average
4.773		63.31% Pervious Area
2.766		36.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	45	0.0520	0.10		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.30"
0.9	203	0.0610	3.98		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
0.3	80	0.0450	4.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.7	320	0.0370	3.10		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
10.5	648	Total			

Subcatchment Pre-1: Offsite Area (Cadence)



Hydrograph for Subcatchment Pre-1: Offsite Area (Cadence)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.17	0.00	0.00
3.00	0.27	0.00	0.00
4.00	0.37	0.00	0.00
5.00	0.49	0.00	0.00
6.00	0.63	0.00	0.05
7.00	0.79	0.02	0.20
8.00	0.99	0.07	0.43
9.00	1.27	0.16	0.87
10.00	1.64	0.33	1.51
11.00	2.17	0.63	2.74
12.00	4.35	2.25	**23.14**
13.00	6.52	4.15	**5.25**
14.00	7.06	4.64	3.20
15.00	7.43	4.98	2.40
16.00	7.71	5.24	1.71
17.00	7.91	5.43	1.34
18.00	8.07	5.58	1.04
19.00	8.21	5.70	0.91
20.00	8.33	5.81	0.82
21.00	8.43	5.91	0.75
22.00	8.53	6.01	0.68
23.00	8.62	6.09	0.61
24.00	**8.70**	**6.16**	0.54
25.00	8.70	6.16	0.00
26.00	8.70	6.16	0.00
27.00	8.70	6.16	0.00
28.00	8.70	6.16	0.00
29.00	8.70	6.16	0.00
30.00	8.70	6.16	0.00
31.00	8.70	6.16	0.00
32.00	8.70	6.16	0.00
33.00	8.70	6.16	0.00
34.00	8.70	6.16	0.00
35.00	8.70	6.16	0.00
36.00	8.70	6.16	0.00
37.00	8.70	6.16	0.00
38.00	8.70	6.16	0.00
39.00	8.70	6.16	0.00
40.00	8.70	6.16	0.00
41.00	8.70	6.16	0.00
42.00	8.70	6.16	0.00
43.00	8.70	6.16	0.00
44.00	8.70	6.16	0.00
45.00	8.70	6.16	0.00
46.00	8.70	6.16	0.00
47.00	8.70	6.16	0.00
48.00	8.70	6.16	0.00
49.00	8.70	6.16	0.00
50.00	8.70	6.16	0.00
51.00	8.70	6.16	0.00
52.00	8.70	6.16	0.00
53.00	8.70	6.16	0.00
54.00	8.70	6.16	0.00
55.00	8.70	6.16	0.00
56.00	8.70	6.16	0.00
57.00	8.70	6.16	0.00
58.00	8.70	6.16	0.00
59.00	8.70	6.16	0.00
60.00	8.70	6.16	0.00
61.00	8.70	6.16	0.00
62.00	8.70	6.16	0.00
63.00	8.70	6.16	0.00
64.00	8.70	6.16	0.00
65.00	8.70	6.16	0.00
66.00	8.70	6.16	0.00
67.00	8.70	6.16	0.00
68.00	8.70	6.16	0.00
69.00	8.70	6.16	0.00
70.00	8.70	6.16	0.00
71.00	8.70	6.16	0.00
72.00	8.70	6.16	0.00

Summary for Subcatchment Pre-2: Existing Site

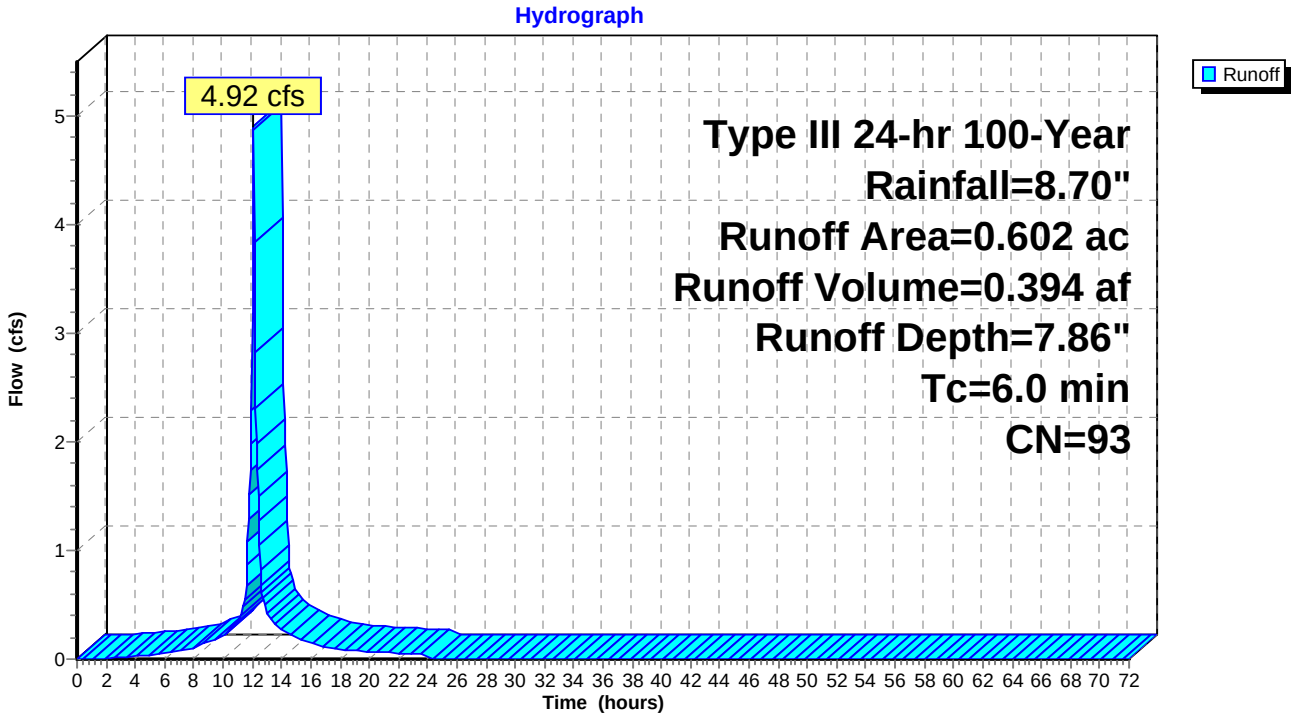
Runoff = 4.92 cfs @ 12.09 hrs, Volume= 0.394 af, Depth= 7.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
*	0.298	98	Existing Pavement
*	0.172	98	Existing Roof
	0.052	70	Woods, Good, HSG C
	0.071	77	Woods, Good, HSG D
*	0.009	74	Existing Grassed Area
	0.602	93	Weighted Average
	0.132		21.93% Pervious Area
	0.470		78.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Subcatchment Pre-2: Existing Site



Hydrograph for Subcatchment Pre-2: Existing Site

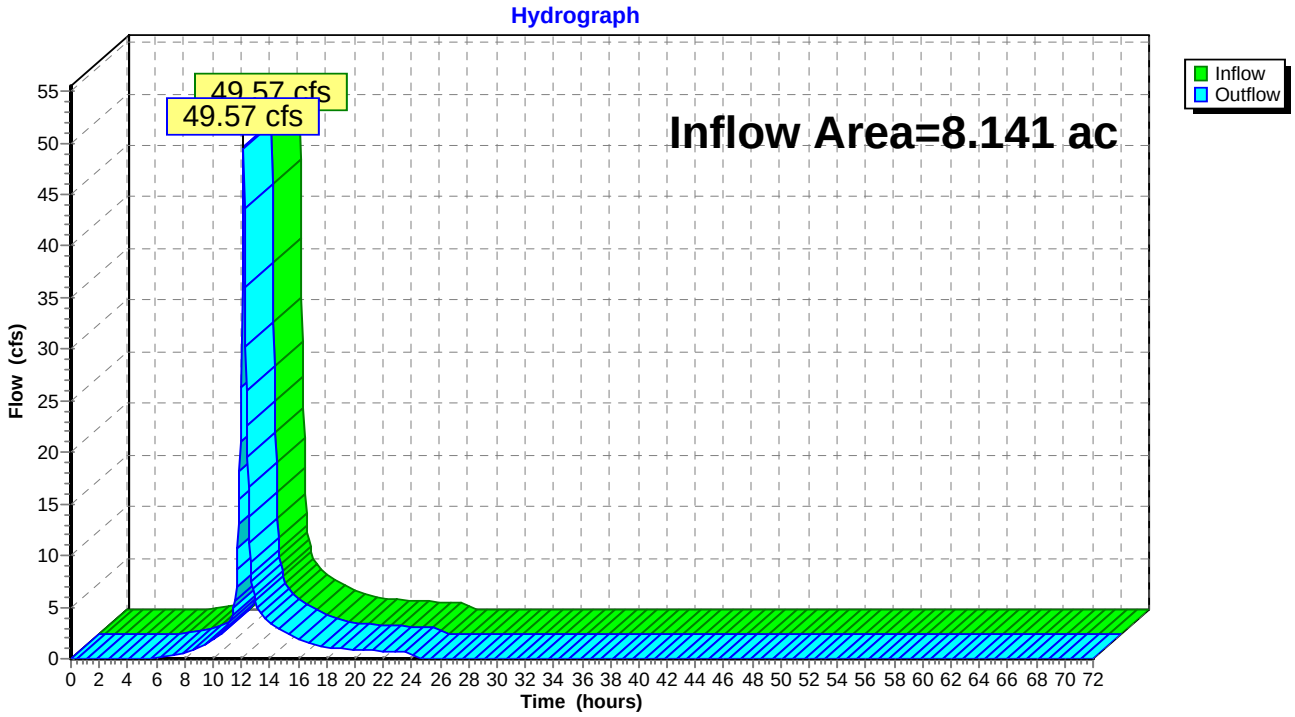
Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.17	0.00	0.00
3.00	0.27	0.02	0.01
4.00	0.37	0.05	0.03
5.00	0.49	0.11	0.04
6.00	0.63	0.18	0.05
7.00	0.79	0.29	0.08
8.00	0.99	0.44	0.10
9.00	1.27	0.67	0.16
10.00	1.64	0.99	0.22
11.00	2.17	1.48	0.35
12.00	4.35	3.56	**3.18**
13.00	6.52	5.70	**0.43**
14.00	7.06	6.23	0.27
15.00	7.43	6.60	0.20
16.00	7.71	6.87	0.14
17.00	7.91	7.08	0.11
18.00	8.07	7.24	0.09
19.00	8.21	7.37	0.08
20.00	8.33	7.49	0.07
21.00	8.43	7.59	0.06
22.00	8.53	7.69	0.06
23.00	8.62	7.78	0.05
24.00	**8.70**	**7.86**	0.05
25.00	8.70	7.86	0.00
26.00	8.70	7.86	0.00
27.00	8.70	7.86	0.00
28.00	8.70	7.86	0.00
29.00	8.70	7.86	0.00
30.00	8.70	7.86	0.00
31.00	8.70	7.86	0.00
32.00	8.70	7.86	0.00
33.00	8.70	7.86	0.00
34.00	8.70	7.86	0.00
35.00	8.70	7.86	0.00
36.00	8.70	7.86	0.00
37.00	8.70	7.86	0.00
38.00	8.70	7.86	0.00
39.00	8.70	7.86	0.00
40.00	8.70	7.86	0.00
41.00	8.70	7.86	0.00
42.00	8.70	7.86	0.00
43.00	8.70	7.86	0.00
44.00	8.70	7.86	0.00
45.00	8.70	7.86	0.00
46.00	8.70	7.86	0.00
47.00	8.70	7.86	0.00
48.00	8.70	7.86	0.00
49.00	8.70	7.86	0.00
50.00	8.70	7.86	0.00
51.00	8.70	7.86	0.00
52.00	8.70	7.86	0.00
53.00	8.70	7.86	0.00
54.00	8.70	7.86	0.00
55.00	8.70	7.86	0.00
56.00	8.70	7.86	0.00
57.00	8.70	7.86	0.00
58.00	8.70	7.86	0.00
59.00	8.70	7.86	0.00
60.00	8.70	7.86	0.00
61.00	8.70	7.86	0.00
62.00	8.70	7.86	0.00
63.00	8.70	7.86	0.00
64.00	8.70	7.86	0.00
65.00	8.70	7.86	0.00
66.00	8.70	7.86	0.00
67.00	8.70	7.86	0.00
68.00	8.70	7.86	0.00
69.00	8.70	7.86	0.00
70.00	8.70	7.86	0.00
71.00	8.70	7.86	0.00
72.00	8.70	7.86	0.00

Summary for Reach DP-1: Design Point

Inflow Area = 8.141 ac, 39.75% Impervious, Inflow Depth = 6.28" for 100-Year event
Inflow = 49.57 cfs @ 12.14 hrs, Volume= 4.262 af
Outflow = 49.57 cfs @ 12.14 hrs, Volume= 4.262 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach DP-1: Design Point



Hydrograph for Reach DP-1: Design Point

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00
1.00	0.00		0.00
2.00	0.00		0.00
3.00	0.01		0.01
4.00	0.03		0.03
5.00	0.04		0.04
6.00	0.11		0.11
7.00	0.28		0.28
8.00	0.53		0.53
9.00	1.03		1.03
10.00	1.74		1.74
11.00	3.09		3.09
12.00	**26.30**		**26.30**
13.00	**5.67**		**5.67**
14.00	3.47		3.47
15.00	2.60		2.60
16.00	1.85		1.85
17.00	1.45		1.45
18.00	1.12		1.12
19.00	0.99		0.99
20.00	0.89		0.89
21.00	0.81		0.81
22.00	0.73		0.73
23.00	0.66		0.66
24.00	0.58		0.58
25.00	0.00		0.00
26.00	0.00		0.00
27.00	0.00		0.00
28.00	0.00		0.00
29.00	0.00		0.00
30.00	0.00		0.00
31.00	0.00		0.00
32.00	0.00		0.00
33.00	0.00		0.00
34.00	0.00		0.00
35.00	0.00		0.00
36.00	0.00		0.00
37.00	0.00		0.00
38.00	0.00		0.00
39.00	0.00		0.00
40.00	0.00		0.00
41.00	0.00		0.00
42.00	0.00		0.00
43.00	0.00		0.00
44.00	0.00		0.00
45.00	0.00		0.00
46.00	0.00		0.00
47.00	0.00		0.00
48.00	0.00		0.00
49.00	0.00		0.00
50.00	0.00		0.00
51.00	0.00		0.00
52.00	0.00		0.00
53.00	0.00		0.00
54.00	0.00		0.00
55.00	0.00		0.00
56.00	0.00		0.00
57.00	0.00		0.00
58.00	0.00		0.00
59.00	0.00		0.00
60.00	0.00		0.00
61.00	0.00		0.00
62.00	0.00		0.00
63.00	0.00		0.00
64.00	0.00		0.00
65.00	0.00		0.00
66.00	0.00		0.00
67.00	0.00		0.00
68.00	0.00		0.00
69.00	0.00		0.00
70.00	0.00		0.00
71.00	0.00		0.00
72.00	0.00		0.00

Summary for Pond Culvert: EX 48" Culvert

Inflow Area = 8.141 ac, 39.75% Impervious, Inflow Depth = 6.29" for 100-Year event
Inflow = 49.66 cfs @ 12.14 hrs, Volume= 4.266 af
Outflow = 49.57 cfs @ 12.14 hrs, Volume= 4.262 af, Atten= 0%, Lag= 0.0 min
Primary = 49.57 cfs @ 12.14 hrs, Volume= 4.262 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 287.50' @ 12.14 hrs Surf.Area= 0.002 ac Storage= 0.002 af

Plug-Flow detention time= 0.6 min calculated for 4.259 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (802.3 - 802.3)

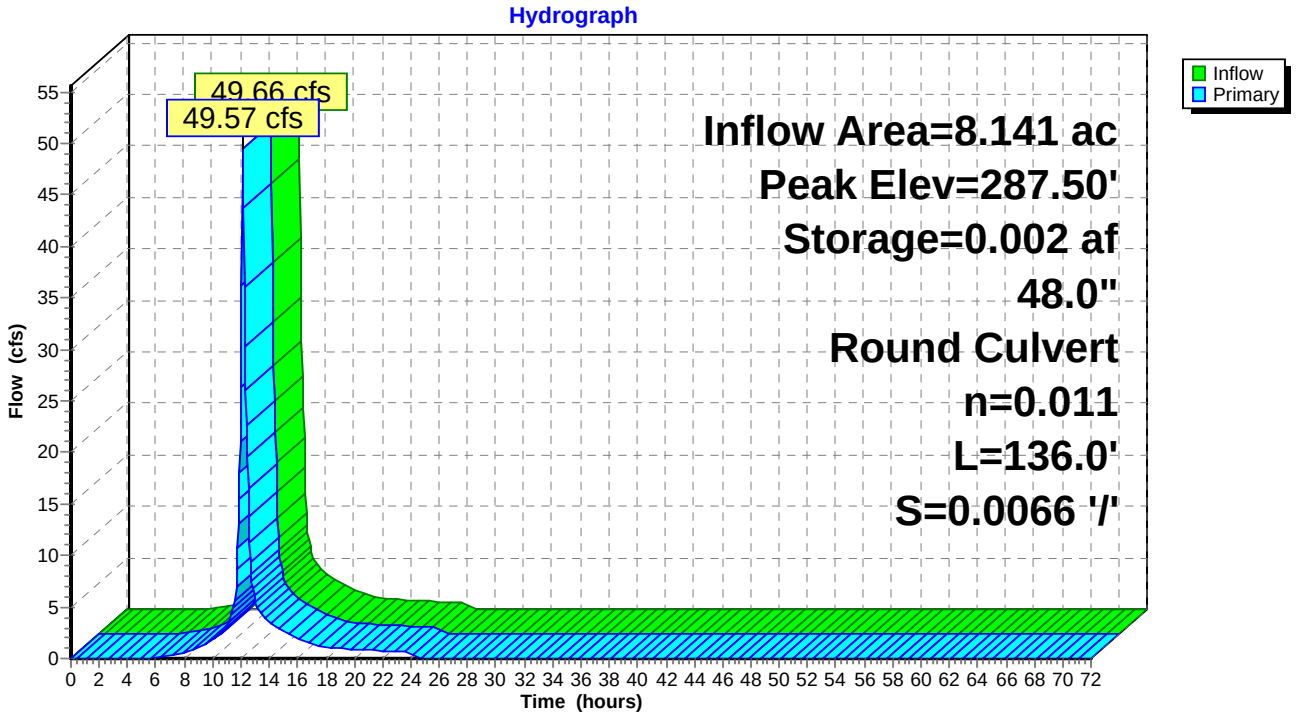
Volume	Invert	Avail.Storage	Storage Description
#1	284.00'	0.019 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
284.00	0.000	0.000	0.000
285.00	0.000	0.000	0.000
286.00	0.000	0.000	0.000
287.00	0.001	0.001	0.001
288.00	0.002	0.002	0.003
289.00	0.007	0.004	0.007
290.00	0.017	0.012	0.019

Device	Routing	Invert	Outlet Devices
#1	Primary	284.66'	**48.0" Round Culvert** L= 136.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 283.76' S= 0.0066 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean

Primary OutFlow Max=48.93 cfs @ 12.14 hrs HW=287.48' (Free Discharge)
1=Culvert (Barrel Controls 48.93 cfs @ 7.26 fps)

Pond Culvert: EX 48" Culvert



Hydrograph for Pond Culvert: EX 48" Culvert

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	284.00	0.00
2.50	0.01	0.000	284.68	0.01
5.00	0.04	0.000	284.73	0.04
7.50	0.39	0.000	284.87	0.39
10.00	**1.74**	**0.000**	**285.10**	**1.74**
12.50	**16.60**	**0.000**	**286.13**	**16.58**
15.00	2.60	0.000	285.21	2.60
17.50	1.29	0.000	285.04	1.29
20.00	0.89	0.000	284.98	0.89
22.50	0.70	0.000	284.94	0.70
25.00	0.00	0.000	284.66	0.00
27.50	0.00	0.000	284.66	0.00
30.00	0.00	0.000	284.66	0.00
32.50	0.00	0.000	284.66	0.00
35.00	0.00	0.000	284.66	0.00
37.50	0.00	0.000	284.66	0.00
40.00	0.00	0.000	284.66	0.00
42.50	0.00	0.000	284.66	0.00
45.00	0.00	0.000	284.66	0.00
47.50	0.00	0.000	284.66	0.00
50.00	0.00	0.000	284.66	0.00
52.50	0.00	0.000	284.66	0.00
55.00	0.00	0.000	284.66	0.00
57.50	0.00	0.000	284.66	0.00
60.00	0.00	0.000	284.66	0.00
62.50	0.00	0.000	284.66	0.00
65.00	0.00	0.000	284.66	0.00
67.50	0.00	0.000	284.66	0.00
70.00	0.00	0.000	284.66	0.00

Stage-Area-Storage for Pond Culvert: EX 48" Culvert

Elevation (feet)	Surface (acres)	Storage (acre-feet)
284.00	0.000	0.000
284.10	0.000	0.000
284.20	0.000	0.000
284.30	0.000	0.000
284.40	0.000	0.000
284.50	0.000	0.000
284.60	0.000	0.000
284.70	0.000	0.000
284.80	0.000	0.000
284.90	0.000	0.000
285.00	0.000	0.000
285.10	0.000	0.000
285.20	0.000	0.000
285.30	0.000	0.000
285.40	0.000	0.000
285.50	0.000	0.000
285.60	0.000	0.000
285.70	0.000	0.000
285.80	0.000	0.000
285.90	0.000	0.000
286.00	0.000	0.000
286.10	0.001	0.000
286.20	0.001	0.000
286.30	0.001	0.000
286.40	0.001	0.000
286.50	0.001	0.001
286.60	0.001	0.001
286.70	0.001	0.001
286.80	0.001	0.001
286.90	0.001	0.001
287.00	0.001	0.001
287.10	0.001	0.001
287.20	0.001	0.001
287.30	0.001	0.001
287.40	0.002	0.002
287.50	0.002	0.002
287.60	0.002	0.002
287.70	0.002	0.002
287.80	0.002	0.002
287.90	0.002	0.003
288.00	0.002	0.003
288.10	0.003	0.003
288.20	0.003	0.003
288.30	0.004	0.004
288.40	0.004	0.004
288.50	0.004	0.004
288.60	0.005	0.005
288.70	0.005	0.005
288.80	0.006	0.006
288.90	0.006	0.007
289.00	0.007	0.007
289.10	0.008	0.008
289.20	0.009	0.009
289.30	0.010	0.010
289.40	0.011	0.011
289.50	0.012	0.012
289.60	0.013	0.013
289.70	0.014	0.014
289.80	0.015	0.016
289.90	0.016	0.017
290.00	**0.017**	**0.019**

Summary for Subcatchment Pst-1: Offsite Area (Cadence)

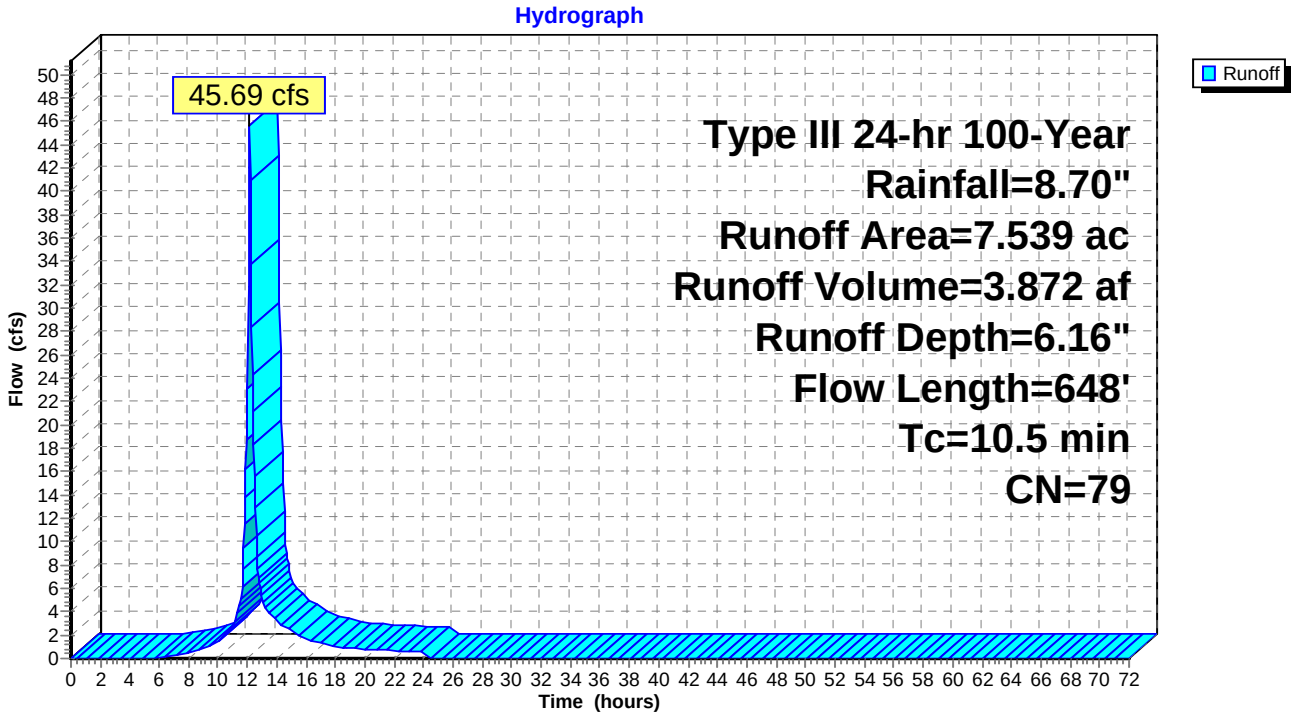
Runoff = 45.69 cfs @ 12.15 hrs, Volume= 3.872 af, Depth= 6.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
1.011	98	Roofs, HSG B
1.755	98	Paved parking, HSG B
1.099	61	>75% Grass cover, Good, HSG B
1.836	74	>75% Grass cover, Good, HSG C
0.110	80	>75% Grass cover, Good, HSG D
0.768	55	Woods, Good, HSG B
0.960	70	Woods, Good, HSG C
7.539	79	Weighted Average
4.773		63.31% Pervious Area
2.766		36.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	45	0.0520	0.10		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.30"
0.9	203	0.0610	3.98		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
0.3	80	0.0450	4.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.7	320	0.0370	3.10		**Shallow Concentrated Flow, Grass** Unpaved Kv= 16.1 fps
10.5	648	Total			

Subcatchment Pst-1: Offsite Area (Cadence)



Hydrograph for Subcatchment Pst-1: Offsite Area (Cadence)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.17	0.00	0.00
3.00	0.27	0.00	0.00
4.00	0.37	0.00	0.00
5.00	0.49	0.00	0.00
6.00	0.63	0.00	0.05
7.00	0.79	0.02	0.20
8.00	0.99	0.07	0.43
9.00	1.27	0.16	0.87
10.00	1.64	0.33	1.51
11.00	2.17	0.63	2.74
12.00	4.35	2.25	**23.14**
13.00	6.52	4.15	**5.25**
14.00	7.06	4.64	3.20
15.00	7.43	4.98	2.40
16.00	7.71	5.24	1.71
17.00	7.91	5.43	1.34
18.00	8.07	5.58	1.04
19.00	8.21	5.70	0.91
20.00	8.33	5.81	0.82
21.00	8.43	5.91	0.75
22.00	8.53	6.01	0.68
23.00	8.62	6.09	0.61
24.00	**8.70**	**6.16**	0.54
25.00	8.70	6.16	0.00
26.00	8.70	6.16	0.00
27.00	8.70	6.16	0.00
28.00	8.70	6.16	0.00
29.00	8.70	6.16	0.00
30.00	8.70	6.16	0.00
31.00	8.70	6.16	0.00
32.00	8.70	6.16	0.00
33.00	8.70	6.16	0.00
34.00	8.70	6.16	0.00
35.00	8.70	6.16	0.00
36.00	8.70	6.16	0.00
37.00	8.70	6.16	0.00
38.00	8.70	6.16	0.00
39.00	8.70	6.16	0.00
40.00	8.70	6.16	0.00
41.00	8.70	6.16	0.00
42.00	8.70	6.16	0.00
43.00	8.70	6.16	0.00
44.00	8.70	6.16	0.00
45.00	8.70	6.16	0.00
46.00	8.70	6.16	0.00
47.00	8.70	6.16	0.00
48.00	8.70	6.16	0.00
49.00	8.70	6.16	0.00
50.00	8.70	6.16	0.00
51.00	8.70	6.16	0.00
52.00	8.70	6.16	0.00
53.00	8.70	6.16	0.00
54.00	8.70	6.16	0.00
55.00	8.70	6.16	0.00
56.00	8.70	6.16	0.00
57.00	8.70	6.16	0.00
58.00	8.70	6.16	0.00
59.00	8.70	6.16	0.00
60.00	8.70	6.16	0.00
61.00	8.70	6.16	0.00
62.00	8.70	6.16	0.00
63.00	8.70	6.16	0.00
64.00	8.70	6.16	0.00
65.00	8.70	6.16	0.00
66.00	8.70	6.16	0.00
67.00	8.70	6.16	0.00
68.00	8.70	6.16	0.00
69.00	8.70	6.16	0.00
70.00	8.70	6.16	0.00
71.00	8.70	6.16	0.00
72.00	8.70	6.16	0.00

Summary for Subcatchment Pst-2: Existing Site

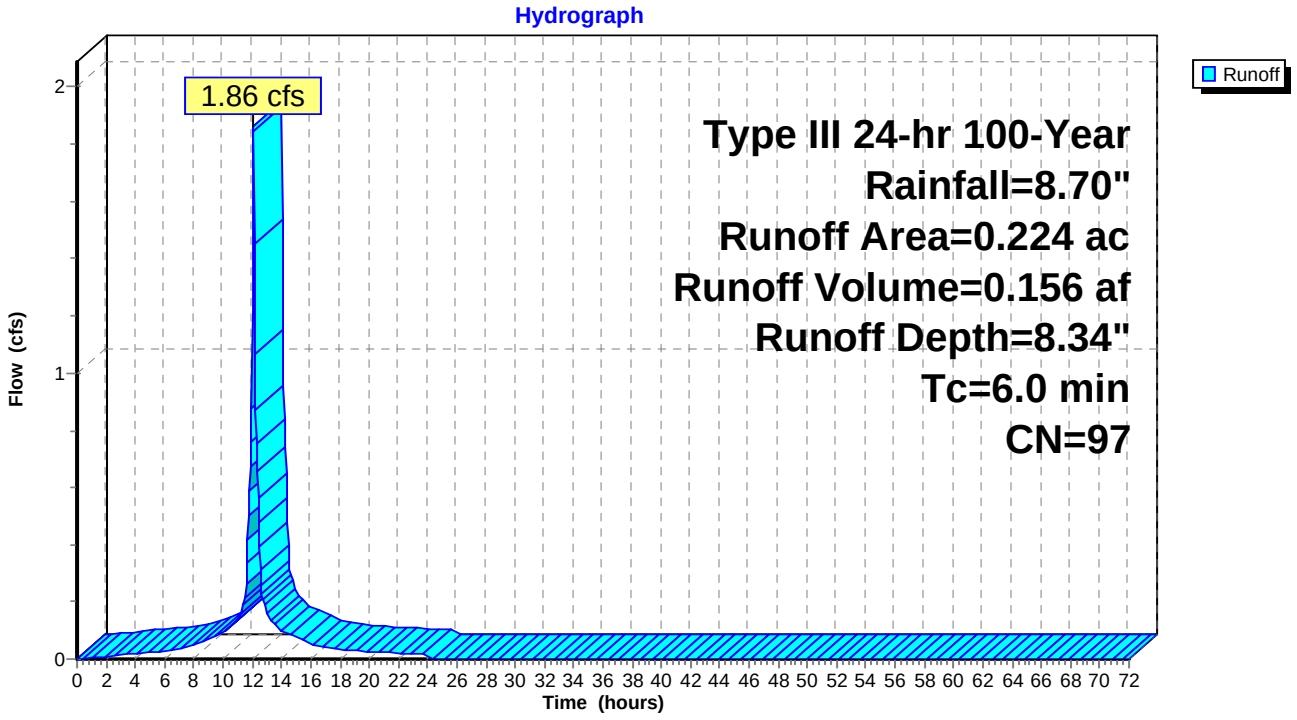
Runoff = 1.86 cfs @ 12.09 hrs, Volume= 0.156 af, Depth= 8.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
*	0.131	98	Existing Pavement
*	0.084	98	Existing Roof
*	0.009	74	Existing Grassed Area
	0.224	97	Weighted Average
	0.009		4.02% Pervious Area
	0.215		95.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Subcatchment Pst-2: Existing Site



Hydrograph for Subcatchment Pst-2: Existing Site

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.17	0.03	0.01
3.00	0.27	0.08	0.01
4.00	0.37	0.16	0.02
5.00	0.49	0.25	0.02
6.00	0.63	0.36	0.03
7.00	0.79	0.51	0.04
8.00	0.99	0.70	0.05
9.00	1.27	0.96	0.07
10.00	1.64	1.32	0.09
11.00	2.17	1.84	0.14
12.00	4.35	4.00	**1.21**
13.00	6.52	6.17	**0.16**
14.00	7.06	6.70	0.10
15.00	7.43	7.07	0.08
16.00	7.71	7.35	0.05
17.00	7.91	7.55	0.04
18.00	8.07	7.71	0.03
19.00	8.21	7.85	0.03
20.00	8.33	7.97	0.03
21.00	8.43	8.07	0.02
22.00	8.53	8.17	0.02
23.00	8.62	8.26	0.02
24.00	**8.70**	**8.34**	0.02
25.00	8.70	8.34	0.00
26.00	8.70	8.34	0.00
27.00	8.70	8.34	0.00
28.00	8.70	8.34	0.00
29.00	8.70	8.34	0.00
30.00	8.70	8.34	0.00
31.00	8.70	8.34	0.00
32.00	8.70	8.34	0.00
33.00	8.70	8.34	0.00
34.00	8.70	8.34	0.00
35.00	8.70	8.34	0.00
36.00	8.70	8.34	0.00
37.00	8.70	8.34	0.00
38.00	8.70	8.34	0.00
39.00	8.70	8.34	0.00
40.00	8.70	8.34	0.00
41.00	8.70	8.34	0.00
42.00	8.70	8.34	0.00
43.00	8.70	8.34	0.00
44.00	8.70	8.34	0.00
45.00	8.70	8.34	0.00
46.00	8.70	8.34	0.00
47.00	8.70	8.34	0.00
48.00	8.70	8.34	0.00
49.00	8.70	8.34	0.00
50.00	8.70	8.34	0.00
51.00	8.70	8.34	0.00
52.00	8.70	8.34	0.00
53.00	8.70	8.34	0.00
54.00	8.70	8.34	0.00
55.00	8.70	8.34	0.00
56.00	8.70	8.34	0.00
57.00	8.70	8.34	0.00
58.00	8.70	8.34	0.00
59.00	8.70	8.34	0.00
60.00	8.70	8.34	0.00
61.00	8.70	8.34	0.00
62.00	8.70	8.34	0.00
63.00	8.70	8.34	0.00
64.00	8.70	8.34	0.00
65.00	8.70	8.34	0.00
66.00	8.70	8.34	0.00
67.00	8.70	8.34	0.00
68.00	8.70	8.34	0.00
69.00	8.70	8.34	0.00
70.00	8.70	8.34	0.00
71.00	8.70	8.34	0.00
72.00	8.70	8.34	0.00

Summary for Subcatchment Pst-3: Proposed Conditions

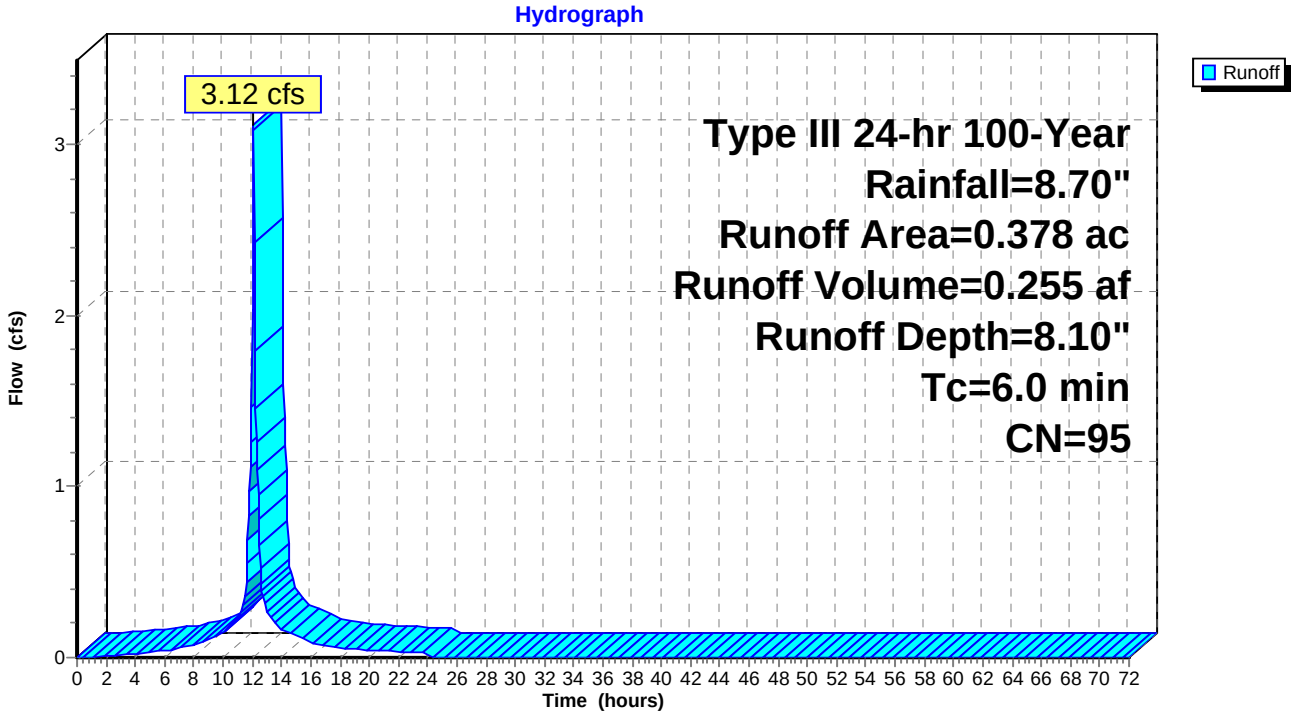
Runoff = 3.12 cfs @ 12.09 hrs, Volume= 0.255 af, Depth= 8.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
*	0.227	98	Existing Pavement
*	0.024	98	Existing Roof
*	0.046	74	Sediment FB/Bioretention Area
*	0.081	98	Stone Storage Area
	0.378	95	Weighted Average
	0.046		12.17% Pervious Area
	0.332		87.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry**

Subcatchment Pst-3: Proposed Conditions



Hydrograph for Subcatchment Pst-3: Proposed Conditions

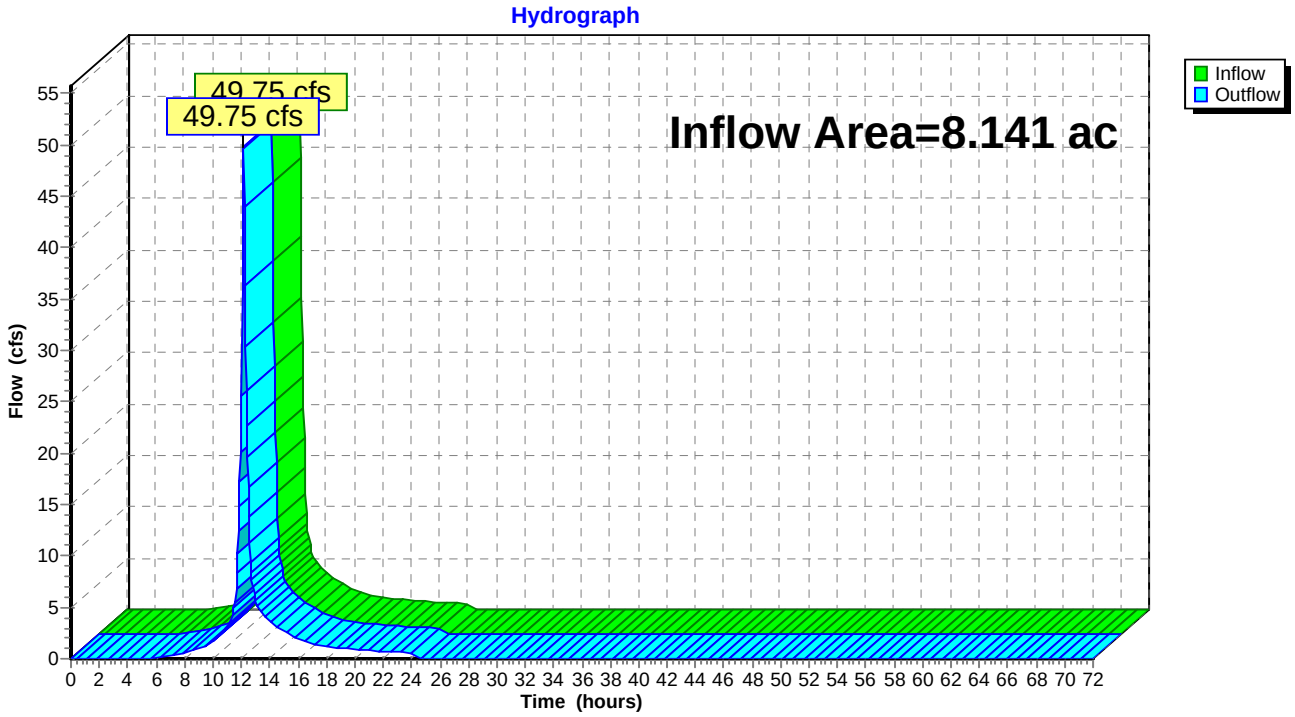
Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.17	0.01	0.01
3.00	0.27	0.04	0.02
4.00	0.37	0.09	0.02
5.00	0.49	0.16	0.03
6.00	0.63	0.26	0.04
7.00	0.79	0.39	0.05
8.00	0.99	0.56	0.07
9.00	1.27	0.80	0.11
10.00	1.64	1.15	0.15
11.00	2.17	1.65	0.22
12.00	4.35	3.78	**2.03**
13.00	6.52	5.93	**0.27**
14.00	7.06	6.46	0.17
15.00	7.43	6.84	0.13
16.00	7.71	7.11	0.09
17.00	7.91	7.31	0.07
18.00	8.07	7.47	0.05
19.00	8.21	7.61	0.05
20.00	8.33	7.73	0.04
21.00	8.43	7.83	0.04
22.00	8.53	7.93	0.04
23.00	8.62	8.02	0.03
24.00	**8.70**	**8.10**	0.03
25.00	8.70	8.10	0.00
26.00	8.70	8.10	0.00
27.00	8.70	8.10	0.00
28.00	8.70	8.10	0.00
29.00	8.70	8.10	0.00
30.00	8.70	8.10	0.00
31.00	8.70	8.10	0.00
32.00	8.70	8.10	0.00
33.00	8.70	8.10	0.00
34.00	8.70	8.10	0.00
35.00	8.70	8.10	0.00
36.00	8.70	8.10	0.00
37.00	8.70	8.10	0.00
38.00	8.70	8.10	0.00
39.00	8.70	8.10	0.00
40.00	8.70	8.10	0.00
41.00	8.70	8.10	0.00
42.00	8.70	8.10	0.00
43.00	8.70	8.10	0.00
44.00	8.70	8.10	0.00
45.00	8.70	8.10	0.00
46.00	8.70	8.10	0.00
47.00	8.70	8.10	0.00
48.00	8.70	8.10	0.00
49.00	8.70	8.10	0.00
50.00	8.70	8.10	0.00
51.00	8.70	8.10	0.00
52.00	8.70	8.10	0.00
53.00	8.70	8.10	0.00
54.00	8.70	8.10	0.00
55.00	8.70	8.10	0.00
56.00	8.70	8.10	0.00
57.00	8.70	8.10	0.00
58.00	8.70	8.10	0.00
59.00	8.70	8.10	0.00
60.00	8.70	8.10	0.00
61.00	8.70	8.10	0.00
62.00	8.70	8.10	0.00
63.00	8.70	8.10	0.00
64.00	8.70	8.10	0.00
65.00	8.70	8.10	0.00
66.00	8.70	8.10	0.00
67.00	8.70	8.10	0.00
68.00	8.70	8.10	0.00
69.00	8.70	8.10	0.00
70.00	8.70	8.10	0.00
71.00	8.70	8.10	0.00
72.00	8.70	8.10	0.00

Summary for Reach DP-1: Design Point

Inflow Area = 8.141 ac, 40.70% Impervious, Inflow Depth = 6.30" for 100-Year event
Inflow = 49.75 cfs @ 12.14 hrs, Volume= 4.275 af
Outflow = 49.75 cfs @ 12.14 hrs, Volume= 4.275 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach DP-1: Design Point



Hydrograph for Reach DP-1: Design Point

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00
1.00	0.00		0.00
2.00	0.01		0.01
3.00	0.01		0.01
4.00	0.02		0.02
5.00	0.02		0.02
6.00	0.08		0.08
7.00	0.26		0.26
8.00	0.51		0.51
9.00	0.98		0.98
10.00	1.73		1.73
11.00	3.06		3.06
12.00	**25.54**		**25.54**
13.00	**5.82**		**5.82**
14.00	3.60		3.60
15.00	2.67		2.67
16.00	1.88		1.88
17.00	1.46		1.46
18.00	1.13		1.13
19.00	0.99		0.99
20.00	0.89		0.89
21.00	0.82		0.82
22.00	0.75		0.75
23.00	0.67		0.67
24.00	0.60		0.60
25.00	0.04		0.04
26.00	0.02		0.02
27.00	0.02		0.02
28.00	0.02		0.02
29.00	0.02		0.02
30.00	0.00		0.00
31.00	0.00		0.00
32.00	0.00		0.00
33.00	0.00		0.00
34.00	0.00		0.00
35.00	0.00		0.00
36.00	0.00		0.00
37.00	0.00		0.00
38.00	0.00		0.00
39.00	0.00		0.00
40.00	0.00		0.00
41.00	0.00		0.00
42.00	0.00		0.00
43.00	0.00		0.00
44.00	0.00		0.00
45.00	0.00		0.00
46.00	0.00		0.00
47.00	0.00		0.00
48.00	0.00		0.00
49.00	0.00		0.00
50.00	0.00		0.00
51.00	0.00		0.00
52.00	0.00		0.00
53.00	0.00		0.00
54.00	0.00		0.00
55.00	0.00		0.00
56.00	0.00		0.00
57.00	0.00		0.00
58.00	0.00		0.00
59.00	0.00		0.00
60.00	0.00		0.00
61.00	0.00		0.00
62.00	0.00		0.00
63.00	0.00		0.00
64.00	0.00		0.00
65.00	0.00		0.00
66.00	0.00		0.00
67.00	0.00		0.00
68.00	0.00		0.00
69.00	0.00		0.00
70.00	0.00		0.00
71.00	0.00		0.00
72.00	0.00		0.00

Summary for Pond Bio-A: Bio - A

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 7.96" for 100-Year event
Inflow = 3.02 cfs @ 12.10 hrs, Volume= 0.251 af
Outflow = 2.96 cfs @ 12.10 hrs, Volume= 0.251 af, Atten= 2%, Lag= 0.5 min
Primary = 2.96 cfs @ 12.10 hrs, Volume= 0.251 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 292.69' @ 12.10 hrs Surf.Area= 951 sf Storage= 631 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 49.2 min (855.1 - 805.9)

Volume	Invert	Avail.Storage	Storage Description
#1	291.75'	475 cf	**Ponding Area (Prismatic)** Listed below (Recalc)
#2	290.00'	192 cf	**Mulch, Bio-media and Pea Gravel (Prismatic)** Listed below (Recalc) 581 cf Overall x 33.0% Voids
		666 cf	Total Available Storage

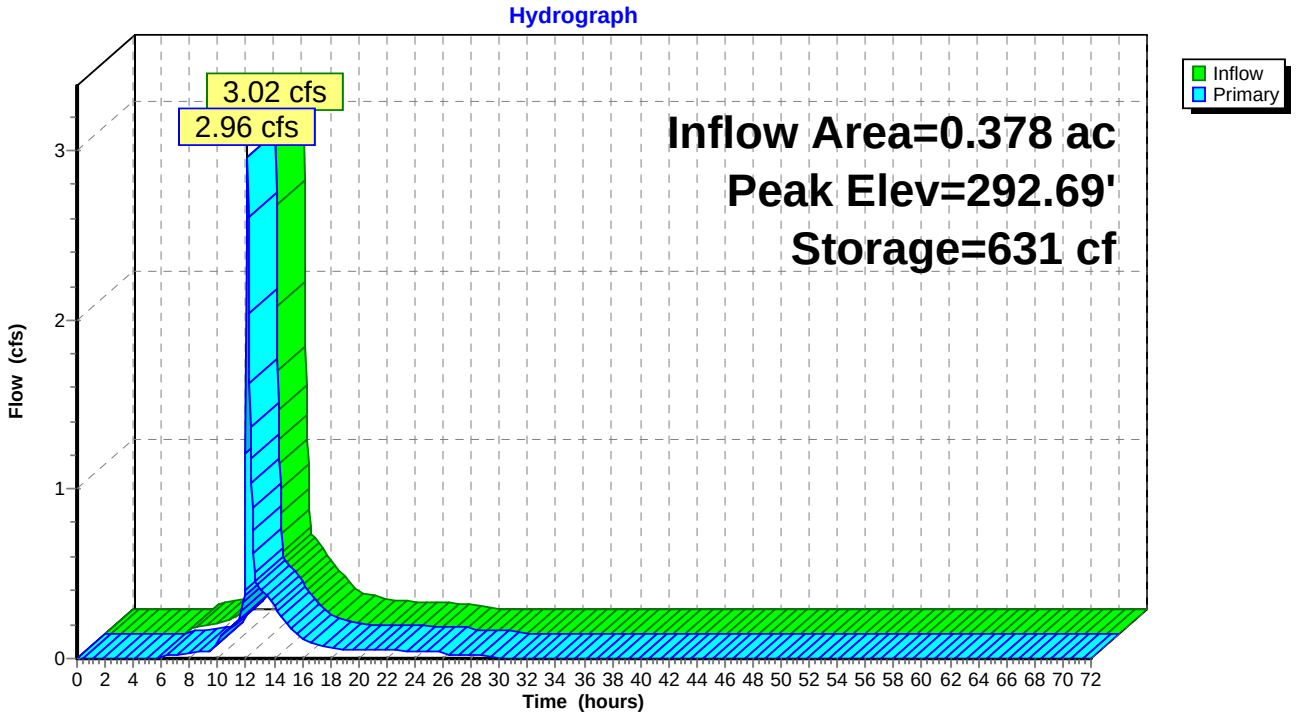
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
291.75	332	0	0
292.50	540	327	327
292.75	642	148	475

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.00	332	0	0
291.75	332	581	581

Device	Routing	Invert	Outlet Devices
#1	Primary	292.50'	**14.0' long x 3.0' breadth Overflow** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	290.00'	**2.410 in/hr Subdrain over Surface area**

Primary OutFlow Max=2.93 cfs @ 12.10 hrs HW=292.69' (Free Discharge)
1=Overflow (Weir Controls 2.88 cfs @ 1.07 fps)
2=Subdrain (Exfiltration Controls 0.05 cfs)

Pond Bio-A: Bio - A



Hydrograph for Pond Bio-A: Bio - A

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	290.00	0.00
2.50	0.00	0	290.00	0.00
5.00	0.00	0	290.00	0.00
7.50	0.05	128	291.17	0.02
10.00	**0.13**	**527**	**292.51**	**0.13**
12.50	**0.72**	**560**	**292.57**	**0.75**
15.00	0.19	532	292.53	0.20
17.50	0.07	522	292.51	0.07
20.00	0.05	517	292.50	0.05
22.50	0.04	455	292.38	0.05
25.00	0.01	302	292.05	0.04
27.50	0.00	105	290.96	0.02
30.00	0.00	0	290.00	0.00
32.50	0.00	0	290.00	0.00
35.00	0.00	0	290.00	0.00
37.50	0.00	0	290.00	0.00
40.00	0.00	0	290.00	0.00
42.50	0.00	0	290.00	0.00
45.00	0.00	0	290.00	0.00
47.50	0.00	0	290.00	0.00
50.00	0.00	0	290.00	0.00
52.50	0.00	0	290.00	0.00
55.00	0.00	0	290.00	0.00
57.50	0.00	0	290.00	0.00
60.00	0.00	0	290.00	0.00
62.50	0.00	0	290.00	0.00
65.00	0.00	0	290.00	0.00
67.50	0.00	0	290.00	0.00
70.00	0.00	0	290.00	0.00

Stage-Area-Storage for Pond Bio-A: Bio - A

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
290.00	332	0
290.05	332	5
290.10	332	11
290.15	332	16
290.20	332	22
290.25	332	27
290.30	332	33
290.35	332	38
290.40	332	44
290.45	332	49
290.50	332	55
290.55	332	60
290.60	332	66
290.65	332	71
290.70	332	77
290.75	332	82
290.80	332	88
290.85	332	93
290.90	332	99
290.95	332	104
291.00	332	110
291.05	332	115
291.10	332	121
291.15	332	126
291.20	332	131
291.25	332	137
291.30	332	142
291.35	332	148
291.40	332	153
291.45	332	159
291.50	332	164
291.55	332	170
291.60	332	175
291.65	332	181
291.70	332	186
291.75	664	192
291.80	678	209
291.85	692	226
291.90	706	245
291.95	719	264
292.00	733	283
292.05	747	304
292.10	761	325
292.15	775	347
292.20	789	369
292.25	803	392
292.30	817	416
292.35	830	441
292.40	844	466
292.45	858	492
292.50	872	519
292.55	892	546
292.60	913	575
292.65	933	604
292.70	954	635
292.75	**974**	**666**

Summary for Pond Culvert: EX 48" Culvert

Inflow Area = 8.141 ac, 40.70% Impervious, Inflow Depth = 6.31" for 100-Year event
Inflow = 49.85 cfs @ 12.14 hrs, Volume= 4.278 af
Outflow = 49.75 cfs @ 12.14 hrs, Volume= 4.275 af, Atten= 0%, Lag= 0.0 min
Primary = 49.75 cfs @ 12.14 hrs, Volume= 4.275 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 287.51' @ 12.14 hrs Surf.Area= 0.002 ac Storage= 0.002 af

Plug-Flow detention time= 1.7 min calculated for 4.275 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (806.9 - 806.9)

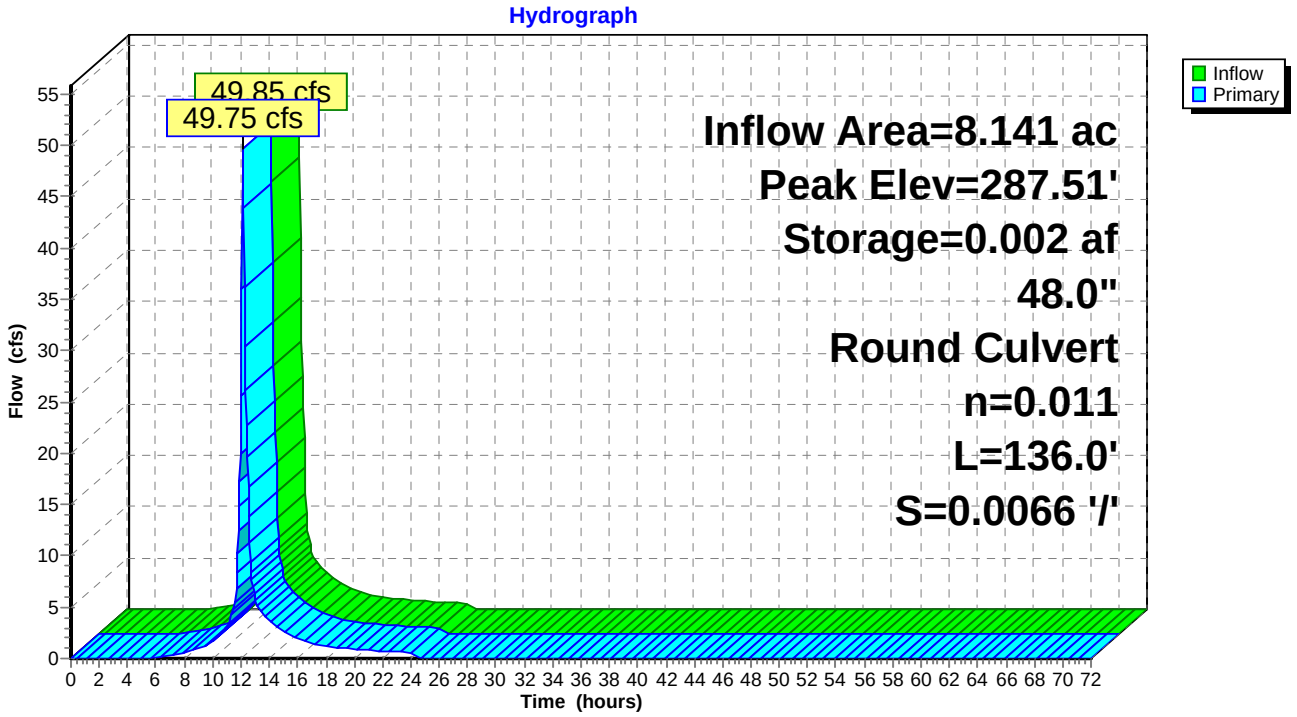
Volume	Invert	Avail.Storage	Storage Description
#1	284.00'	0.019 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
284.00	0.000	0.000	0.000
285.00	0.000	0.000	0.000
286.00	0.000	0.000	0.000
287.00	0.001	0.001	0.001
288.00	0.002	0.002	0.003
289.00	0.007	0.004	0.007
290.00	0.017	0.012	0.019

Device	Routing	Invert	Outlet Devices
#1	Primary	284.66'	**48.0" Round Culvert** L= 136.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 283.76' S= 0.0066 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean

Primary OutFlow Max=49.16 cfs @ 12.14 hrs HW=287.49' (Free Discharge)
1=Culvert (Barrel Controls 49.16 cfs @ 7.27 fps)

Pond Culvert: EX 48" Culvert



Hydrograph for Pond Culvert: EX 48" Culvert

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	284.00	0.00
2.50	0.01	0.000	284.69	0.01
5.00	0.02	0.000	284.71	0.02
7.50	0.37	0.000	284.86	0.37
10.00	**1.73**	**0.000**	**285.10**	**1.73**
12.50	**16.70**	**0.000**	**286.14**	**16.68**
15.00	2.67	0.000	285.21	2.67
17.50	1.30	0.000	285.04	1.30
20.00	0.89	0.000	284.98	0.89
22.50	0.71	0.000	284.94	0.71
25.00	0.04	0.000	284.73	0.04
27.50	0.02	0.000	284.70	0.02
30.00	0.00	0.000	284.66	0.00
32.50	0.00	0.000	284.66	0.00
35.00	0.00	0.000	284.66	0.00
37.50	0.00	0.000	284.66	0.00
40.00	0.00	0.000	284.66	0.00
42.50	0.00	0.000	284.66	0.00
45.00	0.00	0.000	284.66	0.00
47.50	0.00	0.000	284.66	0.00
50.00	0.00	0.000	284.66	0.00
52.50	0.00	0.000	284.66	0.00
55.00	0.00	0.000	284.66	0.00
57.50	0.00	0.000	284.66	0.00
60.00	0.00	0.000	284.66	0.00
62.50	0.00	0.000	284.66	0.00
65.00	0.00	0.000	284.66	0.00
67.50	0.00	0.000	284.66	0.00
70.00	0.00	0.000	284.66	0.00

Stage-Area-Storage for Pond Culvert: EX 48" Culvert

Elevation (feet)	Surface (acres)	Storage (acre-feet)
284.00	0.000	0.000
284.10	0.000	0.000
284.20	0.000	0.000
284.30	0.000	0.000
284.40	0.000	0.000
284.50	0.000	0.000
284.60	0.000	0.000
284.70	0.000	0.000
284.80	0.000	0.000
284.90	0.000	0.000
285.00	0.000	0.000
285.10	0.000	0.000
285.20	0.000	0.000
285.30	0.000	0.000
285.40	0.000	0.000
285.50	0.000	0.000
285.60	0.000	0.000
285.70	0.000	0.000
285.80	0.000	0.000
285.90	0.000	0.000
286.00	0.000	0.000
286.10	0.001	0.000
286.20	0.001	0.000
286.30	0.001	0.000
286.40	0.001	0.000
286.50	0.001	0.001
286.60	0.001	0.001
286.70	0.001	0.001
286.80	0.001	0.001
286.90	0.001	0.001
287.00	0.001	0.001
287.10	0.001	0.001
287.20	0.001	0.001
287.30	0.001	0.001
287.40	0.002	0.002
287.50	0.002	0.002
287.60	0.002	0.002
287.70	0.002	0.002
287.80	0.002	0.002
287.90	0.002	0.003
288.00	0.002	0.003
288.10	0.003	0.003
288.20	0.003	0.003
288.30	0.004	0.004
288.40	0.004	0.004
288.50	0.004	0.004
288.60	0.005	0.005
288.70	0.005	0.005
288.80	0.006	0.006
288.90	0.006	0.007
289.00	0.007	0.007
289.10	0.008	0.008
289.20	0.009	0.009
289.30	0.010	0.010
289.40	0.011	0.011
289.50	0.012	0.012
289.60	0.013	0.013
289.70	0.014	0.014
289.80	0.015	0.016
289.90	0.016	0.017
290.00	**0.017**	**0.019**

Summary for Pond FB: Sediment Forebay

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 8.11" for 100-Year event
Inflow = 3.06 cfs @ 12.09 hrs, Volume= 0.255 af
Outflow = 3.02 cfs @ 12.10 hrs, Volume= 0.251 af, Atten= 1%, Lag= 0.1 min
Primary = 3.02 cfs @ 12.10 hrs, Volume= 0.251 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 292.80' @ 12.10 hrs Surf.Area= 161 sf Storage= 254 cf

Plug-Flow detention time= 24.7 min calculated for 0.251 af (98% of inflow)
Center-of-Mass det. time= 10.0 min (805.9 - 795.9)

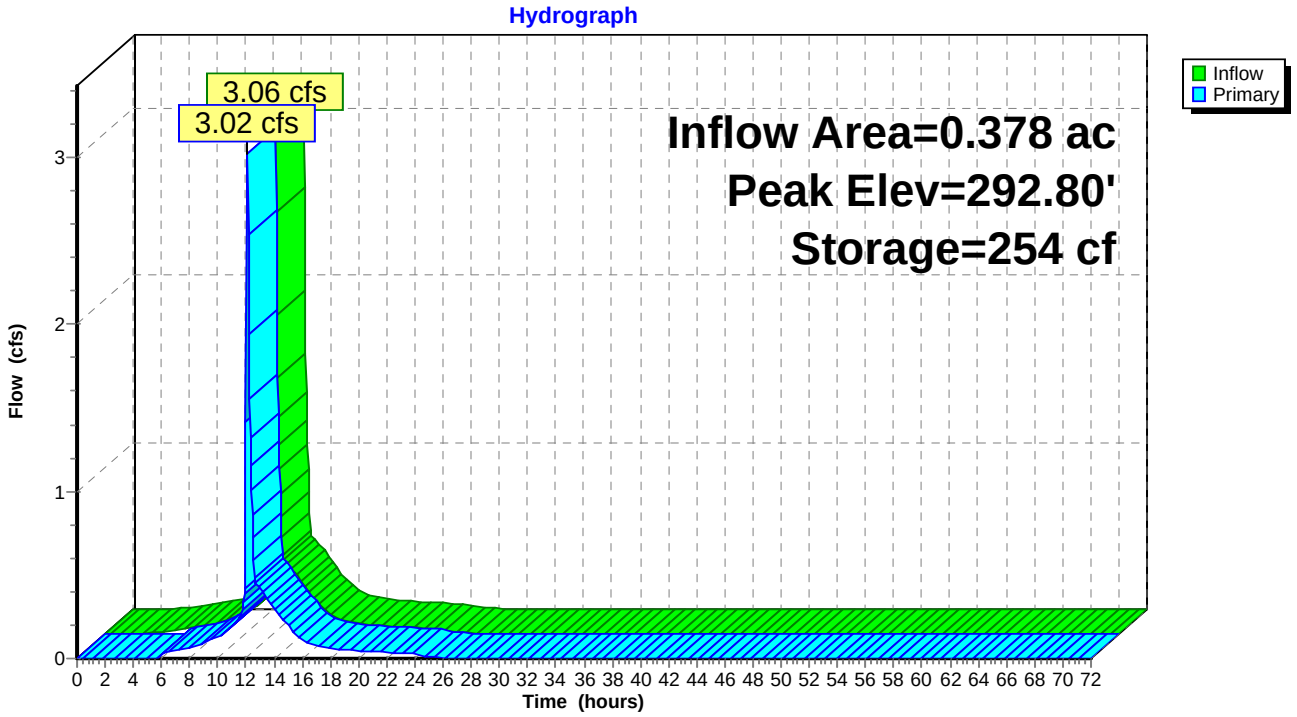
Volume	Invert	Avail.Storage	Storage Description
#1	290.50'	286 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.50	65	0	0
291.00	83	37	37
292.00	123	103	140
292.50	146	67	207
293.00	170	79	286

Device	Routing	Invert	Outlet Devices
#1	Primary	292.50'	**7.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=2.99 cfs @ 12.10 hrs HW=292.80' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 2.99 cfs @ 1.41 fps)

Pond FB: Sediment Forebay



Hydrograph for Pond FB: Sediment Forebay

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	290.50	0.00
2.50	0.00	1	290.52	0.00
5.00	0.02	99	291.65	0.00
7.50	0.05	210	292.52	0.05
10.00	**0.13**	**213**	**292.54**	**0.13**
12.50	**0.71**	**225**	**292.62**	**0.72**
15.00	0.19	214	292.55	0.19
17.50	0.07	211	292.53	0.07
20.00	0.05	210	292.52	0.05
22.50	0.04	209	292.51	0.04
25.00	0.01	208	292.50	0.01
27.50	0.00	207	292.50	0.00
30.00	0.00	207	292.50	0.00
32.50	0.00	207	292.50	0.00
35.00	0.00	207	292.50	0.00
37.50	0.00	207	292.50	0.00
40.00	0.00	207	292.50	0.00
42.50	0.00	207	292.50	0.00
45.00	0.00	207	292.50	0.00
47.50	0.00	207	292.50	0.00
50.00	0.00	207	292.50	0.00
52.50	0.00	207	292.50	0.00
55.00	0.00	207	292.50	0.00
57.50	0.00	207	292.50	0.00
60.00	0.00	207	292.50	0.00
62.50	0.00	207	292.50	0.00
65.00	0.00	207	292.50	0.00
67.50	0.00	207	292.50	0.00
70.00	0.00	207	292.50	0.00

Stage-Area-Storage for Pond FB: Sediment Forebay

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
290.50	65	0
290.55	67	3
290.60	69	7
290.65	70	10
290.70	72	14
290.75	74	17
290.80	76	21
290.85	78	25
290.90	79	29
290.95	81	33
291.00	83	37
291.05	85	41
291.10	87	46
291.15	89	50
291.20	91	54
291.25	93	59
291.30	95	64
291.35	97	69
291.40	99	73
291.45	101	78
291.50	103	84
291.55	105	89
291.60	107	94
291.65	109	99
291.70	111	105
291.75	113	111
291.80	115	116
291.85	117	122
291.90	119	128
291.95	121	134
292.00	123	140
292.05	125	146
292.10	128	153
292.15	130	159
292.20	132	166
292.25	135	172
292.30	137	179
292.35	139	186
292.40	141	193
292.45	144	200
292.50	146	207
292.55	148	215
292.60	151	222
292.65	153	230
292.70	156	237
292.75	158	245
292.80	160	253
292.85	163	261
292.90	165	269
292.95	168	278
293.00	**170**	**286**

Summary for Pond ST: Stone Storage Area

Inflow Area = 0.378 ac, 87.83% Impervious, Inflow Depth = 8.10" for 100-Year event
Inflow = 3.12 cfs @ 12.09 hrs, Volume= 0.255 af
Outflow = 3.06 cfs @ 12.09 hrs, Volume= 0.255 af, Atten= 2%, Lag= 0.4 min
Primary = 3.06 cfs @ 12.09 hrs, Volume= 0.255 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 292.52' @ 12.09 hrs Surf.Area= 3,512 sf Storage= 1,587 cf

Plug-Flow detention time= 38.6 min calculated for 0.255 af (100% of inflow)
Center-of-Mass det. time= 40.6 min (795.9 - 755.3)

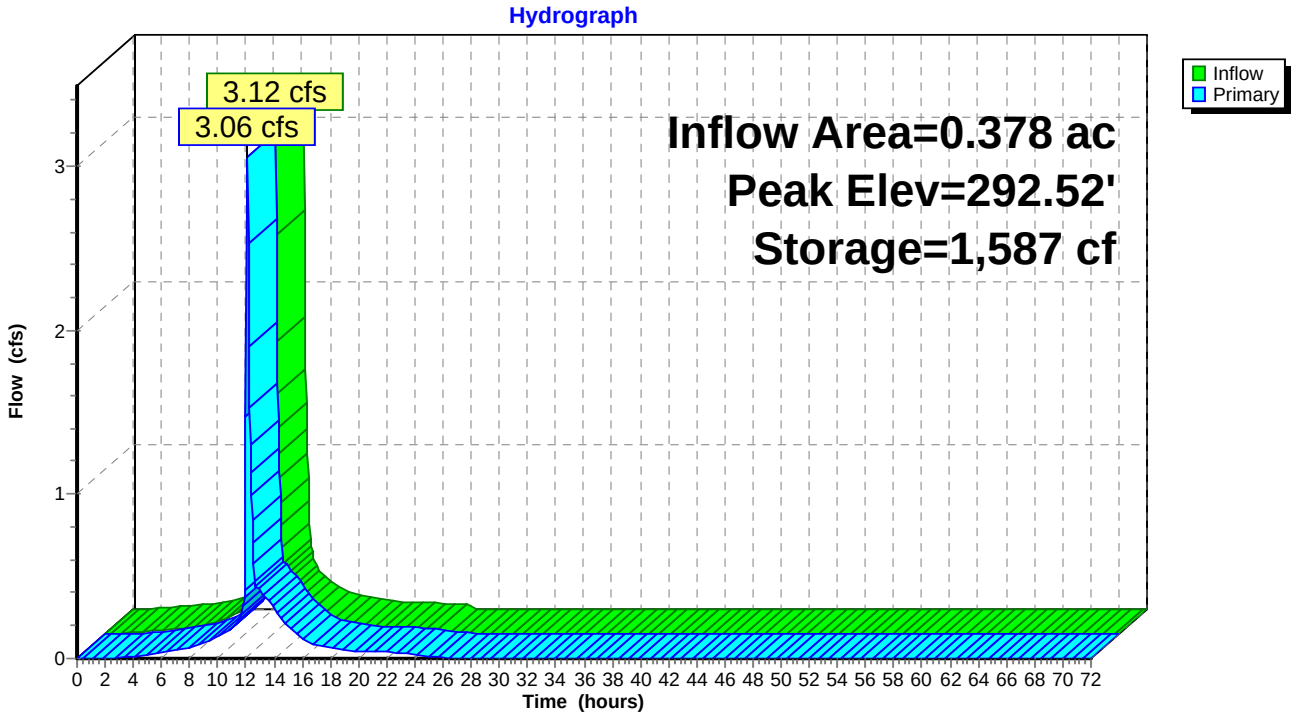
Volume	Invert	Avail.Storage	Storage Description
#1	291.15'	1,773 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 5,373 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
291.15	3,512	0	0
292.68	3,512	5,373	5,373

Device	Routing	Invert	Outlet Devices
#1	Primary	291.15'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	292.43'	**36.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=3.01 cfs @ 12.09 hrs HW=292.52' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.46 cfs @ 5.28 fps)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 2.55 cfs @ 0.80 fps)

Pond ST: Stone Storage Area



Hydrograph for Pond ST: Stone Storage Area

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	291.15	0.00
2.50	0.01	23	291.17	0.00
5.00	0.03	116	291.25	0.02
7.50	0.06	182	291.31	0.05
10.00	**0.15**	**308**	**291.42**	**0.13**
12.50	**0.66**	**1,505**	**292.45**	**0.71**
15.00	0.13	438	291.53	0.19
17.50	0.06	211	291.33	0.07
20.00	0.04	166	291.29	0.05
22.50	0.03	145	291.28	0.04
25.00	0.00	74	291.21	0.01
27.50	0.00	33	291.18	0.00
30.00	0.00	20	291.17	0.00
32.50	0.00	15	291.16	0.00
35.00	0.00	11	291.16	0.00
37.50	0.00	8	291.16	0.00
40.00	0.00	6	291.16	0.00
42.50	0.00	4	291.15	0.00
45.00	0.00	3	291.15	0.00
47.50	0.00	2	291.15	0.00
50.00	0.00	2	291.15	0.00
52.50	0.00	1	291.15	0.00
55.00	0.00	1	291.15	0.00
57.50	0.00	1	291.15	0.00
60.00	0.00	0	291.15	0.00
62.50	0.00	0	291.15	0.00
65.00	0.00	0	291.15	0.00
67.50	0.00	0	291.15	0.00
70.00	0.00	0	291.15	0.00

Stage-Area-Storage for Pond ST: Stone Storage Area

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
291.15	**3,512**	0
291.17	3,512	23
291.19	3,512	46
291.21	3,512	70
291.23	3,512	93
291.25	3,512	116
291.27	3,512	139
291.29	3,512	162
291.31	3,512	185
291.33	3,512	209
291.35	3,512	232
291.37	3,512	255
291.39	3,512	278
291.41	3,512	301
291.43	3,512	325
291.45	3,512	348
291.47	3,512	371
291.49	3,512	394
291.51	3,512	417
291.53	3,512	440
291.55	3,512	464
291.57	3,512	487
291.59	3,512	510
291.61	3,512	533
291.63	3,512	556
291.65	3,512	579
291.67	3,512	603
291.69	3,512	626
291.71	3,512	649
291.73	3,512	672
291.75	3,512	695
291.77	3,512	719
291.79	3,512	742
291.81	3,512	765
291.83	3,512	788
291.85	3,512	811
291.87	3,512	834
291.89	3,512	858
291.91	3,512	881
291.93	3,512	904
291.95	3,512	927
291.97	3,512	950
291.99	3,512	974
292.01	3,512	997
292.03	3,512	1,020
292.05	3,512	1,043
292.07	3,512	1,066
292.09	3,512	1,089
292.11	3,512	1,113
292.13	3,512	1,136
292.15	3,512	1,159
292.17	3,512	1,182
292.19	3,512	1,205
292.21	3,512	1,228
292.23	3,512	1,252
292.25	3,512	1,275
292.27	3,512	1,298
292.29	3,512	1,321
292.31	3,512	1,344
292.33	3,512	1,368
292.35	3,512	1,391
292.37	3,512	1,414
292.39	3,512	1,437
292.41	3,512	1,460
292.43	3,512	1,483
292.45	3,512	1,507
292.47	3,512	1,530
292.49	3,512	1,553
292.51	3,512	1,576
292.53	3,512	1,599
292.55	3,512	1,623
292.57	3,512	1,646
292.59	3,512	1,669
292.61	3,512	1,692
292.63	3,512	1,715
292.65	3,512	1,738
292.67	3,512	**1,762**

Watershed Maps

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Subcatchment Information
Subcat Pre-1: Area = 7.539, CN = 79, Tc = 10.5 Min.
Subcat Pre-2: Area = 0.602, CN = 93, Tc = 6.0 Min.

Total Area= 8.141 Acres

Legend

- Woods - B Soils
- Woods - C Soils
- Woods - D Soils
- Grass - B Soils
- Grass - C Soils
- Grass - D Soils
- Impervious

Legend

- Tc Line (1A, 1B)
- Subcat Area
- Soil Boundary
- Subcatchment (100)
- Drainage Pond/Bio Retention/ Infiltrating Swale (100)
- Reach/Swale (100)

Note:

Pre-1 is an offsite area and is the same from pre to post development conditions. The values used are consistent with the analysis done previously for the Cadence Science Development. Pre-2 covers the area of the proposed development.

A pond are has been modeled for the area preceding the existing 48" culvert.

Scale: 1"=40'
0 20' 40' 80'

DiPrete Engineering
Two Stafford Court Cranston, RI 02920
tel 401-943-1000 fax 401-464-6006 www.DiPrete-Eng.com
Engineers • Planners • Surveyors

No.	Issuance	Date	Description	By:
			RIDEM Submission	PJC

Drawn By: A.C.A. Design By: J.P.C.

Post Development Watershed

2050 Plainfield Pike

Cranston, Rhode Island

Owner/Applicant
DSD Enterprises, LLC
2050 Plainfield Pike, Cranston, Rhode Island 02921
tel (401) 943-0005

SHEET 2 OF 2

Subcatchment Information

Subcat Pst-1:	Area = 7.539,	CN = 79, Tc = 10.5 Min.
Subcat Pst-2:	Area = 0.224,	CN = 97, Tc = 6.0 Min.
Subcat Pst-3	Area = 0.378,	CN = 95, Tc = 6.0 Min.

Total Area= 8.141 Acres

Legend

- Woods - B Soils
- Woods - C Soils
- Grass - B Soils
- Grass - C Soils
- Impervious

Legend

- Tc Line (1A, 1B)
- Subcat Area
- Soil Boundary
- Subcatchment (100)
- Drainage Pond/Bio Retention/ Infiltrating Swale (100)
- Reach/Swale (100)

Note:

Pst-1 is an offsite area and is the same from pre to post development conditions. The values used are consistent with the analysis done previously for the Cadence Science Development. Pst-2 and Pst-3 cover the area of the proposed development.

A pond are has been modeled for the area preceding the existing 48" culvert.

Scale: 1"=40'
0 20' 40' 80'

DiPrete Engineering
Engineers • Planners • Surveyors
Two Stafford Court Cranston, RI 02920
tel 401-943-1000 fax 401-464-6006 www.DiPrete-Eng.com

This regulatory submission set shall not be used for construction purposes unless Stamped "Issued for Construction" and signed by a DiPrete Engineering representative.

The contractor is responsible for all of the means, methods, safety precautions and requirements, and OSHA conformance in the implementation of this plan and design.

No.	Issue/Date	Description	By
	Drawn By: A.C.A.		Design By: J.P.C.

Post Development Watershed

2050 Plainfield Pike

Cranston, Rhode Island

Owner/Applicant
DSD Enterprises, LLC
2050 Plainfield Pike, Cranston, Rhode Island 02921
tel (401) 943-0005

SHEET 2 OF 2

A3.5.4.8 2012 Application to Alter Wetlands by Sovereign Consulting Inc.

SOVEREIGN CONSULTING INC.

Science. Service. Solutions.

APPLICATION TO ALTER A FRESHWATER WETLAND
WRITTEN EVALUATION
FOR SUBMISSION TO
RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

FOR

EAST SIDE ENTERPRISES LLC
2050 PLAINFIELD PIKE
CRANSTON, RI 02921
PLAT 36-2, LOT 117

Prepared by:

Sovereign Consulting Inc.

16 Chestnut Street, Suite 520
Foxborough, MA 02035

Laura Simkins — Project Ecologist

Eric Simpson — Program Manager

November 12, 2012

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ATTACHMENTS

1.0 INTRODUCTION

Sovereign Consulting Inc. (Sovereign) prepared this *Application to Alter a Freshwater Wetland Written Evaluation* on behalf of East Side Enterprises LLC (East Side) for the property located at 2050 Plainfield Pike in Cranston, Rhode Island (RI) (site). This property is identified by the City of Cranston as Plat 36-2, Lot 117. Currently, the site is developed with an auto-repair building and associated paved parking area. The southern portion of the property is forested. The purposes of the activities described herein were to ascertain whether freshwater wetlands exist within areas of proposed disturbance associated with the addition of a stone vehicle storage area, and if so, to evaluate the wetland functions, values and impacts of the proposed disturbance.

2.0 SITE AND BACKGROUND INFORMATION

2.1 Site Description

The subject parcel is located in a commercial area of Cranston, RI and is bounded by Plainfield Pike to the north and Sailor Way to the east. A property owned by Cadence Science, Inc. (Cadence) abuts the East Side property to the west and south. The forested portion of the East Side property is located along the southern and southwestern property lines and the forested area continues onto the abutting Cadence property. An aerial photograph of the site and surrounding areas is included in the DiPrete Engineering Associates, Inc. (DiPrete) Civil Plans submitted with this application.

As part of a previous application with the Rhode Island Department of Environmental Management (RIDEM) under file DEM OCTA 12-005, regulated freshwater wetlands associated with the forested area on this site were field delineated and verified by RIDEM. The previous application also identified a regulated intermittent stream on the east side of the subject property with associated 100 foot riverbank buffer and floodplain. A site layout plan, included with the DiPrete Civil Plans submitted with this application, depicts the verified located of a forested wetland within the property boundary of the site (designated by the C-series delineation line) and the location of the intermittent stream.

Due to the wetland's topographic position in relation to the surrounding streets and parking areas, it is centrally located to receive runoff from the East Side property and parking areas, the Cadence property parking lots to the west, and the Cadence property access road with associated grassed shoulder located to the south of the wetland. Two emergent wetlands are present to the south of the access road on property owned by Cadence, however there appears to be no hydraulic connection between the emergent wetlands and the forested wetland. It should be noted that proposed alterations to the emergent wetland communities to the south of the access road are under review in DEM file OCTA 12-020.

The following profssionals are assisting the prime applicant in the submission of this Application to Alter a Freshwater Wetland:

- DiPrete Engineering Associates, Inc. – Professional Engineer/Professional Land Surveyor
- Sovereign Consulting Inc. – Wetland Consultant

3.0 RULE 10.00 APPLICATION TO ALTER A FRESHWATER WETLAND

In accordance with RIDEM's Office of Water Resources, the submission of an Application to Alter a Freshwater Wetland requires documentation of responses to the following sections.

3.1 Rule 10.02A: Project Scope

The proposed project includes the addition of a stone vehicle storage area on the southern edge of the current parking lot, over an area that is currently forested. The stone vehicle storage area, measuring approximately 3,512 square feet (sq ft), will have a liner and a subdrain which will discharge to a sediment forebay and bioretention area.

This project will require alteration to some of the regulated wetland and intermittent stream associated with this property and may have a lesser affect on the remainder of this regulated wetland located on the adjacent property owned by Cadence. In order to construct the stone vehicle storage area, a portion of the forested wetland (approx 3,096 sq ft) will be filled. An additional 1,931 sq ft of disturbance will occur within the 100' riverbank buffer in order to construct the sediment forebay and bioretention area.

Appropriate best management practices have been incorporated into the project design. Specifically, the sediment forebay and bioretention basin will aid in stormwater management by improving water quality and aiding in flood control of stormwater runoff from the surrounding impervious surfaces prior to reaching the wetland and intermittent stream channel. There is presently no flood control nor water quality improvement features in this area. The potential loss in flood storage from the elimination of a portion of the forested wetland will be counterbalanced by the addition of the stormwater management system.

3.2 Rule 10.02B: General Provisions

This Application includes all specific requirements, including:

1) An original, completed application form;
2) Site plans, prepared by DiPrete, accurately depicting the proposed project and including the correct location, extent, and type of all wetlands within and near the project;
3) The application fee;
4) Proof of ownership in the form of a current certified copy of the deed of the project property;
5) A current list and map, prepared by DiPrete, showing property owners whose properties lie within two hundred feet of the outermost boundary of the area of the proposed wetland alterations;

6) All written evaluations and documentation as reported in the content of this evaluation report;
7) When the project applicant receives notice from RIDEM, the required number of copies of the site plan, as necessary for distribution by RIDEM, will be provided;
8) The required field work has been completed by DiPrete and Sovereign.

3.3 Rule 10.02D: Avoidance and Minimization Requirement

The following sections address the potential impacts to freshwater wetland functions from the proposed project and the steps the applicant has taken to avoid and minimize impacts to freshwater wetlands to the maximum extent possible.

3.3.1 Avoidance

The complete avoidance of freshwater wetland impacts cannot be achieved due to the extent of freshwater wetlands within the limited property available to the applicant. At present, all available developable space outside of the wetlands is utilized on the property. In order to expand the applicant's vehicle storage area, some impact to the wetland will be sustained. However, impacts will be minimized by design features, as discussed below.

a) This project is not water dependant. It does not require access to freshwater wetlands as a central element of its primary purpose. Alternative locations that would have no impact on the wetland do not exist on the limited extent of the property, therefore wetland alterations are proposed in order to meet project goals.
b) The location of the proposed project could not be altered due to the location of freshwater wetlands on the applicant's property, which occupy the remainder of the undeveloped portion of the property. No alternative locations are present on the property which could be used to meet project goals while avoiding all impacts to freshwater wetlands. In order to preserve the wetland to the greatest extent possible, the stone vehicle storage area is limited in size to minimally intrude on the wetland and the remainder of the wetland will be left intact. Plantings and biological monitoring, as described in further detail below, will be conducted within the remaining wetland to restore it and enhance its value.
c) The subject property is located within a commercial area of Cranston, RI. Adjacent properties are developed and occupied by separate commercial entities. The project purpose is to create a limited (3,512 sq ft), additional vehicle storage area adjacent to the currently existing paved parking area. There are no readily available alternative properties that could be acquired in the vicinity of the site in order to complete this limited scope and meet its intended purpose.
d) Due to the unavailability of alternative areas for development within the applicant's property, no alternative designs or technologies would provide a greater level of impact avoidance to freshwater wetlands. Alternative layouts were not possible due to the presence of freshwater wetlands on the remainder of the undeveloped portion of the property. However, the design and technology of the project is intended to reduce its overall impact to freshwater wetlands. Implementation of a stormwater management system, as described in

detail below, will improve water quality and aiding in flood control of stormwater runoff from the surrounding impervious surfaces prior to reaching the wetland and intermittent stream channel.

e) Alternative project locations on the applicant's property were not possible due to the presence of freshwater wetlands on the remainder of the undeveloped portion of the property. No zoning or infrastructure constraints limited the selection of a location for the proposed project. Development is limited by the applicant's parcel size, however, the subject parcel cannot be expanded by land acquisition due to the development of adjacent properties by separate commercial entities and/or location of a neighboring small cemetery.
f) The current project design, or any known alternatives, will not adversely affect public health, safety, or the environment.

3.3.2 Minimization

Although complete avoidance of the freshwater wetland impacts can not be attained, the project goal can be achieved with a reduced impact to freshwater wetlands. The forested wetland on the subject property has functional value in the landscape. In order to minimize loss to the value of the wetland from the proposed project, the applicant will restore and enhance the remaining wetland post-construction with manual removal of invasive woody vines and application of a native seed mix of hydrophytic vegetation. The loss of vegetation, particularly woody growth, within the disturbed area will be mitigated with plantings of like woody species along the edge of the stone storage area and bioretention basin once construction is complete. These plantings will provide additional flood storage to compensate for the loss of wetland vegetation within the disturbed area. In order to ensure that minimal habitat is lost for rodents, reptiles, and amphibians, the rock wall in place at the current southern edge of the parking area will be dismantled and re-created at the southern edge of the stone storage area. Other rock walls existing within the forested wetland will not be affected by the proposed project. Any habitat restoration will be monitored for success once the proposed project is complete, with additional plantings made as needed.

The following issues address the applicant's intent to minimize impacts to freshwater wetlands to the greatest extent possible.

a) The project purpose is to create the minimal vehicle storage necessary to meet the applicant's goals, while keeping the vehicle storage area adjacent to the currently existing paved parking area. In order to preserve the wetland to the greatest extent possible, the vehicle storage area is limited in scale (3,512 sq ft) to minimally intrude on the wetland. The remainder of the wetland will be left intact. Plantings and biological monitoring will be conducted within the remaining wetland to restore it and enhance its value.
b) The location of the proposed project could not be altered due to the location of freshwater wetlands on the applicant's property, which occupy the remainder of the undeveloped portion of the property. No alternative locations on the property would provide a greater level of impact minimization to freshwater wetlands.

c) The design and technology of the project is intended to reduce its impact to freshwater wetlands. Implementation of the stormwater management system will improve water quality and aid in flood control of stormwater runoff from the surrounding impervious surfaces prior to reaching the wetland and intermittent stream channel.
d) Neither the current project design, nor any relocation or reduction in the current project scale will adversely affect public health, safety, or the environment.

3.3.3 Mitigation Measures

Appropriate mitigation measures will be implemented during and following the construction of the vehicle storage area. To protect water quality within the wetland from any adverse or significant effects, erosion control barriers will be installed at work limits in locations shown on the site layout plan within the DiPrete Civil Plans. The wetland will be monitored for erosion and sedimentation on a regular basis until construction ceases and the surrounding grade stabilizes.

During construction of the vehicle storage area, rock walls will be dismantled and reconstructed at the perimeter of the area of disturbance in order to preserve existing wildlife habitat.

The loss of vegetation, particularly woody growth, within the disturbed area will be mitigated with plantings of like woody species along the edge of the disturbed area once construction is complete. The remaining existing wetland will be further enhanced with the manual removal of invasive woody vines and the application of native seed mix. The enhancements will be designed to increase the value of the existing wetland. Re-vegetation will be monitored for success once the proposed project is complete, with additional plantings made as needed.

3.4 Rule 10.02E: Evaluation of Wetland Functions, Values and Impacts

3.4.1 Evaluation Methodology

Sovereign conducted a site visit on November 1, 2012. Upon entering the site, Sovereign personnel noted that the wetland delineation boundary previously flagged for Application No. OCTA 12-005 was still visible. Sovereign reviewed this line and verified the wetland extents using a routine assessment of vegetation, hydrology, and soil conditions. Wetland delineation procedures followed the "routine method" outlined in the Corps 1987 Wetlands Delineation Manual, as modified by U.S. Army Corps of Engineers Interim *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (2009)*.

Wildlife habitat was assessed and evaluated at the site using a combination of direct observation and physical evidence. The habitat features of the property were noted in order to identify potential habitat value and species that have the potential to utilize the site.

Additional outside data resources used to evaluate the site consisted of U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) maps for the presence of hydric soil units found within the study area and available RI Geographic Information Systems (RIGIS) data layers for historical aerial photographs, FEMA flood zones, sites of historical or geological or archeological significance, presence or absence of rare species and/or habitats, U.S. Geological Society (USGS) maps for topography and perennial streams, and National Wetland Inventory (NWI) maps for area wetland classifications and connectivity.

3.4.2 Qualifications

Sovereign Consulting personnel involved in the evaluation of the subject property include:

- Eric Simpson, PG, LSP
- Laura Simkins, Ecologist
- Ellyn Brixius, Senior Wetland Biologist

Detailed statements of qualification are presented in **Attachment A**.

3.4.3 Freshwater Wetland Characteristics

The forested wetland located on the East Side and Cadence properties is relatively small in size, with the *C-series* measuring approximately 11,307 sq ft. Although the wetland is less than 1 acre in size, it is hydraulically connected to downgradient wetlands due to an intermittent stream (<10 cfs) running along the southeasten edge of the property abutting Sailor Way, which is fed from stormwater entering from the East Side property. Within the wetland, shallow channels which seasonally contain surface water meet the intermittent stream on the eastern edge of the property. At the confluence, surface water flows through a culvert beneath Sailor Way into a drainage ditch on the property owned by Cranston Industrial LLC across Sailor Way. This drainage ditch extends along the Cranston Industrial property and Interstate 295 and flows into a forested wetland approximately 2,970 ft east of the site. This network of surface water is identified as part of the Meshanticut Brook watershed and the intermittent stream on the subject property serves as a headwater, therefore, a 100 ft riverbank boundary is applicable to this stream and the surrounding wetlands on the subject property are jurisdictional. Per conversations with RIDEM, additional federal and state permits, such as a Programmatic General Permit (PGP) with the New England Division of the U.S. Army Corps of Engineers (USACE) and/or compliance permit with the U.S. Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) and Rhode Island Pollutant Discharge Elimination System (RIPDES), are not applicable to the site and will not be included for concurrent submittal with this application.

The wetland receives stormwater entering through culverts at the wetland's northwest and southwest corners, both of which are located on the Cadence property. Water is channeled to the center of the forested wetland, due to gentle sloping topography, and eventually exits through the culvert on the eastern property boundary beneath Sailor Way. This culvert also receives water from the intermittent stream flowing on the east

side. During the November site visit, this stream channel contained approximately three inches of water and was approximately 3-5 feet in width. The substrate was a sand and gravel mixture, consistent with surrounding soils. The banks were undercut, indicating that the stream receives fast flowing water from runoff during storm events. The 100-ft riverbank buffer associated with the intermittent stream is shown on the Site Layout Plan included in the DiPrete Civil Plans.

Due to the wetland's topographic position in relation to the surrounding streets and parking areas, it is centrally located to receive runoff from the East Side property and parking areas, the Cadence property parking lots to the west, and the Cadence property access road located to the south of the wetland. No standing water was present during the November site visit, with the exception of within the intermittent stream channel, however, hydric soil conditions were present near the soil surface, indicating that groundwater is shallow. The extent of seasonal flooding to the wetland is influenced by surface water flows from the culverts entering the wetland from the west and from the upland areas surrounding the wetland.

The wetland is densely vegetated with a mix of overstory, understory, and herbaceous vegetation. The overstory is reduced and the shrub layer is most dense on the northwest side of the wetland where a disturbance may have occurred historically. This part of the wetland is not within the proposed project area. The following vegetation was observed to be dominant during the November site visit, however herbaceous vegetation was noted to be seasonally limited at the time.

Common Name	Scientific Name	Vegetative Layer
red maple	*Acer rubrum*	overstory
grey birch	*Betula populifolia*	overstory
northern arrowwood	*Viburnum recognitum*	understory
silky dogwood	*Cornus ammomum*	understory
glossy buckthorn	*Rhamnus frangula*	understory
Elderberry	*Sambucus canadensis*	understory
poison ivy	*Toxicodendron radicans*	woody vine
sensitive fern	*Onoclea sensibilis*	herbaceous
giant goldenrod	*Solidago gigantea*	herbaceous
jewelweed	*Impatiens capensis*	herbaceous

Undeveloped upland areas in the vicinity of the wetland are limited to the forested area surrounding the wetland and the mowed, grassy shoulder of the access road to the south of the wetland. The following vegetation was observed to be dominant in upland areas: red maple (*Acer rubrum*), grey birch (*Betula populifolia*), eastern cottonwood (*Populous deltoides*), black cherry (*Prunus serotina*), glossy buckthorn (*Rhamnus frangula*), smooth sumac (*Rhus glabra*), multiflora rose (*Rosa multiflora*), field bindweed (*Convolvulus arvensis*), climbing nightshade (*Solanum dulcamara*), wrinkleleaf goldenrod (*Solidago rugosa*), and poison ivy (*Toxicodendron radicans*).

3.4.4 Wildlife and Wildlife Habitat

Wildlife Indicators – During the November 1, 2012 site visit, wildlife habitat was assessed and evaluated at the site using a combination of direct observation, including vocalizations, and physical evidence or signs of habitation by particular species (scat, nests, tree cavities, etc).

The following species were observed during the November site visit:

Common Name	Scientific Name
American robin	*Turdus migratorius*
northern blue jay	*Cyanocitta cristata*
mourning dove	*Zenaida macroura*
black-capped chickadee	*Parus atricapillus*
red-winged blackbird	*Agelaius phoeniceus*
hairy woodpecker	*Picoides villosus*
common grackle	*Quiscalus quiscula*
song sparrow	*Melospiza melodia*
northern mockingbird	*Mimus polyglottos*
eastern chipmunk	*Tamias striatus*

Wetland Values - The small size and location of the forested wetland within a densely developed, commercial area of Cranston, RI limits the value of the wetland for habitat. Other forested wetlands exist within a half mile from the site, but they have no connectivity with the subject site, which is surrounded by commercial properties and paved roads with high traffic. Although the emergent wetland to the south has different potential habitat value than the forested wetland, its close proximity could increase the number and diversity of species in the area. In particular, species that could exploit both types of habitat would benefit from the combined area. However, the paved access road to the south of the subject site separates the two wetlands and isolates them from one another, making them less likely to enhance the other's value. The subject wetland is most likely to be used by opportunistic species that are common in urban environments and species that are generally unaffected by noise and visual disturbances related to humans. For these reasons, it is unlikely to provide habitat for rare species or species that are sensitive to human presence.

The habitat features of the property were noted in order to identify potential habitat value and specific species that have the potential to utilize the site. The hydraulic regime of the subject wetland is diverse with multiple entry points for stormwater, several flow channels through the wetland, and areas of ponding during wetter periods of the growing season which can be assumed by the buttressed roots of red maples and the reduced conditions of the soil. It is unknown if ponding during an average growing season occurs at the subject site for a long enough period to create vernal pools, however, this possibility will be considered as a conservative assumption. Breeding herptiles would utilize these pools of standing water for breeding purposes, however,

the general area lacks significant upland habitat equally required for herptiles and the surrounding mowed and paved surfaces are likely to increase herptile mortality.

During the site visit, no snags were observed, however a few downed logs and two rock walls provide cover habitat for small rodents and herptiles. The dense shrub undergrowth existing on the northwestern portion of the wetland provides cover and nesting habitat for a variety of bird species. Thick leaf litter with woody debris provides potential cover and foraging for herptiles and small rodents.

Below is a list of herptile species with potential to utilize the habitat available within the subject property:

Common Name	Scientific Name
eastern American toad	*Bufo a. americanus*
northern brown snake	*Storeria d. dekayi*
common garter snake	*Thamnophis sirtalis*
northern ringneck snake	*Diadophis punctatus edwardsii*
redback salamander	*Plethodon cinereus*
northern two-lined salamander	*Eurycea bislineata*
wood frog	*Rana sylvatica*
box turtle	*Terrapene carolina carolina*

In addition to small rodents, the subject site contains potential cover and foraging or hunting habitat for small and medium size mammals. However, the limited upland area and isolation of the site among busy roadways restricts wider potential use. Below is a list of mammal species with potential to utilize the habitat available within the subject property:

Common Name	Scientific Name
white-footed mouse	*Peromyscus leucopus*
masked shrew	*Sorex cinereus*
little brown myotis	*Myotis lucifugus*
short-tailed shrew	*Sylvilagus floridanus*
eastern cottontail	*Marmota monax*
coyote	*Canis latrans*
red fox	*Vulpes vulpes*
striped skunk	*Mephitis mephitis*
raccoon	*Procyon lotor*
Virginia opossum	*Didelphis virginiana*

For avian species, the structural diversity of the subject wetland provides a dense overstory for roosting and nesting habitat and the understory shrub layer and herbaceous layer provides cover and foraging potential. Avian species, particularly

migrants, which tend to be less restricted by a fragmented landscape, may utilize this wetland in conjunction with nearby forested wetlands.

Below is a list of additional avian species with potential to utilize the habitat available within the subject property:

Common Name	Scientific Name
barn swallow	*Hirundo rustica*
bobolink	*Dolichonyx oryzivorus*
brown thrasher	*Toxostoma rufum*
chipping sparrow	*Spizella passerina*
common yellowthroat	*Geothlypis trichas*
eastern phoebe	*Sayornis phoebe*
european starling	*Sturnus vulgaris*
gray catbird	*Dumetella carolinensis*
house sparrow	*Passer domesticus*
house wren	*Troglodytes aedon*

Proposed Impacts – The proposed project will involve a disturbance of 3,096 sq ft within the northern edge of the subject wetland in order to accommodate the stone vehicle storage area. An additional disturbance of 1,931 sq ft to accommodate the sediment forebay and bioretention basin will occur adjacent to the intermittent stream, within the riverbank buffer. The wetland will not be eliminated by any proposed impacts, however, its area will be reduced. Likewise, the removal of trees and other vegetation within the disturbed area will reduce potential wildlife habitat. Still, the size and location of the current wetland along with the fragmented nature of the surrounding landscape limit overall habitat potential for most species. The subject wetland is most likely to be used by opportunistic species that are common in urban environments and species that are generally unaffected by noise and visual disturbances related to humans. For these reasons, it is unlikely to provide habitat for rare species or species that are sensitive to human presence. Upon additional review of the RIGIS Natural Heritage Area data layer, the subject property was not known to provide habitat for rare plant and animal species.

To compensate for the loss in area from the proposed improvements and to increase the value of the wetland, habitat enhancements on the remainder of the wetland are proposed. Currently, extensive woody vines (i.e. poison ivy) are present within the herbaceous layer, preventing a diversity of herbaceous species from colonizing the area. Manual removal of the woody vines and application of a native wetland plant seed mix will enhance vegetative species diversity within the wetland. In order to construct the vehicle storage area, vegetation will be removed from this portion of the wetland and the ground surface will be filled in this area to match the grade of the existing paved parking area. Native shrubs consistent with the current understory layer (i.e. northern arrowwood and/or silky dogwood) will be planted along the perimeter of the disturbed area to speed re-vegetation of optimal species. The rock wall along the current paved

parking area will be dismantled in order to accommodate the adjacent vehicle storage area, but will be reconstructed around the disturbed area to mitigate this habitat loss.

3.4.5 Recreation and Aesthetics

The site contains limited open space value in the densely developed surrounding area. Due to its size and location, it provides limited aesthetic value and although public access is not formally restricted by fence or other barrier, any use of the property by the public would be considered trespassing on private land. Viewing opportunities from Sailor Way are unrestricted, however, limited photographic opportunities or public viewing is available due to the high-use of the roadway. The small size of the wetland does not encourage opening up the property to public use for hunting and/or trapping. The size of the stream and its intermittent nature do not provide recreational activities such as fishing, and no significant surface water body exists on the property for recreational activities.

No geological or archaeological sites were observed or identified by RIGIS data layers for the property. In summary, the proposed project is not likely to impact the property's open space or recreational value, as this value is limited by lack of public access and lack of important cultural or historic features.

Water quality within the stream is not expected to decrease with the site developments. The stream will still receive surface water runoff from the impervious surfaces to the north on the East Side property. However, once the stormwater treatments are in place, runoff waters resulting from the proposed development will enter the stormwater retention area for treatment prior to being discharged to the stream. Refer to the DiPrete Stormwater Report submitted as part of this application for a detailed description of the proposed design. In addition, the volume of the stormwater discharged will be steady. Therefore, stormwater runoff from the proposed development will not exacerbate stream flooding during high rain events and further undercutting of the stream banks due to high volume flow will be avoided. The other two entry points for stormwater runoff on the west side of the wetland will be unaffected by the proposed project.

3.4.6 Flood Protection

The subject site is located within FEMA Flood Zone X, which is outside the 500-year flood zone. The proposed project will remove some flood storage capacity from the wetland, however, the unaffected portion of the wetland containing the majority of flood channels will remain intact. The proposed stormwater management system will handle and treat surface water runoff from the proposed development and will compensate for the loss of flood storage from the removal of vegetation in the disturbed area. In addition, shrub species will be planted to assist in flood storage. These mitigation techniques are designed to enhance the existing wetland in order to maintain its capacity for flood protection for adjacent areas. Refer to the DiPrete Stormwater Report submitted as part of this application for a detailed description of compensatory flood storage.

3.4.7 Groundwater and Surface Water Supplies

The subject wetland receives stormwater entering through culverts at the wetland's northwest and southwest corners, as well as the surrounding uplands. Groundwater is shallow, with some saturation appearing within 1-2 feet of the surface, as evident based on field observations. Surface waters pool in certain portions of the wetland, while shallow channels exist within the eastern portion where surface waters appear to flow during high flow periods. The filling of a portion of the wetland is not expected to impact groundwater supply, since the vehicle storage area is elevated above the elevation of the wetland at the existing grade of the paved parking area. The proposed project may reduce some surface water infiltration in the northern portion of the wetland due to the impervious surface of the vehicle storage area, but the project is unlikely to affect the groundwater elevation or water quality of the remaining wetland, which will remain intact. Surface water runoff resulting from the proposed development will be collected in the proposed stormwater management system, which will maintain or improve the quality of surface water runoff entering the intermittent stream. For additional supporting data, including the volumes of water diverted and the rate and duration of the diversions, refer to the DiPrete Stormwater Report submitted as part of this application.

3.4.8 Water Quality

The subject wetland functions as a natural treatment system for pollutants in surface water runoff entering from the adjacent properties. The proposed project is not likely to impact the ability of the remaining wetland area to function at its current level. The additional proposed wetland enhancements - plantings to aid in flood storage and seeding to aid in species diversity - will improve water quality by optimizing the wetland to trap and store nutrients and other pollutants.

During the entirety of the construction phase of the proposed vehicle storage area, erosion control measures will be kept in place to preserve surface water quality and prevent unnecessary sedimentation. As previously mentioned, surface water runoff resulting from the proposed development will be collected in the proposed stormwater management system, which will maintain or improve the quality of surface water runoff entering the intermittent stream. For additional supporting data, including a water quality analysis, refer to the DiPrete Stormwater Report submitted as part of this application.

3.4.9 Soil Erosion and Sediment Control

The applicant will install controls, including hay bales and silt fencing, in the areas of proposed disturbance to limit erosion and sedimentation during all construction activities. These controls will be monitored until the construction phase is complete, to ensure no excess sediment is reaching the wetland and intermittent stream. For additional supporting data on erosion and sedimentation controls, refer to the DiPrete Stormwater Report submitted as part of this application.

3.5 Rule 10.05: Review Criteria

The following responses to the review criteria outlined in Rule 10.05C of the Rules and Regulations demonstrate that the proposed project would not adversely impact wetland functions and values.

1) No significant reduction in the overall wildlife production or diversity of the subject wetland is likely. Habitat value of the wetland is currently limited by size, isolation, and location of the site in a highly fragmented commercial area. Wildlife diversity is generally restricted to opportunistic species that are common in urban environments and species that are generally unaffected by noise and visual disturbances related to humans. Some transient species may use the habitat during migration, however, this possibility will not be affected by the proposed project, as the surrounding wetland outside of the area of disturbance will remain intact.

2) The needs of wildlife species in particular are not likely to be affected by the proposed project. High structural diversity and complex hydrology within the remaining wetland area meet the needs of wildlife utilizing the wetland and no significant alteration to these features is expected by the proposed project.

3) No significant displacement of wildlife is expected due to the proposed project as the surrounding wetland area outside of the area of disturbance will remain intact. This adjacent area will satisfy the needs of species utilizing the wetland. The rock wall within the project zone will be reconstructed on the perimeter of the area of disturbance to re-create cover habitat for use by wildlife.

4) Based on a site visit and additional data from RIGIS on the presence or absence of rare species and/or habitats at the site location, no rare animal or plant species are known to be located on or utilizing the subject site. Therefore, no impacts to rare species will result from the proposed project.

5) No rare wetland types are known to exist at the site, therefore no impacts to rare wetlands will result from the proposed project.

6) The proposed work will result in a small area disturbance within the subject wetland, however, the suitability of the wetland as a whole for use by wildlife is not likely to be affected by the proposed project. High structural diversity and complex hydrology within the remaining wetland area meet the needs of wildlife utilizing the wetland and no significant alteration to these features is expected by the proposed project. The value of the site as a feeding, resting, nesting, and breeding area for wildlife will continue within the surrounding wetland area outside of the area of disturbance, which will remain intact. Cover lost by the vegetation removal in the disturbance area will be mitigated by plantings of optimal wetland value along the project perimeter. As stated previously, the rock wall within the project zone will be reconstructed on the perimeter of the area of disturbance to re-create cover habitat for use by wildlife. Due to the

fragmented nature of the surrounding landscape and the paved properties surrounding the site, the subject wetland does not have high value as a travel corridor for wildlife. Therefore, no impacts to potential travel corridors for wildlife will result from the proposed project.

7) The proposed project is not likely to increase invasive or exotic plant or animal species within the subject wetland. The site currently houses multiple exotic plant species which decrease the value of the overall wetland. In order to increase its value, as well as mitigate any potential impacts from the proposed project, manual removal of invasive vegetation will be conducted and a native seed mix applied to the areas affected. This will promote species diversity within the plant community and enhance the wetland's value as wildlife habitat.

8) In general, the wildlife species associated with utilization of the site are common, urban species tolerant of human disturbance. No state or federal fish, game, or wildlife agencies are actively involved with the management of the subject property.

9) Public access to the site is not formally restricted by fence or other barrier, but any use of the property by the public would be considered trespassing on private land. Therefore, recreational opportunities for the public not available on the subject property and photographic or viewing opportunities from Sailor Way are limited due to the high use of the roadway. No impacts to recreational use are likely to result from the proposed project.

10) No scientific studies or observations are known to be on-going at the subject site or in the immediate vicinity. Therefore, no impacts to scientific studies will result from the proposed project.

11) The subject site is on private land and any use of the property by the public would be considered trespassing. No traditional human access ways to the wetland or intermittent stream have been identified at the subject site, therefore, none will be impacted by the proposed project.

12) The proposed project is not likely to impact the ability of the remaining wetland area to function at its current level as a natural treatment system for pollutants in surface water runoff entering from the adjacent properties. The additional proposed wetland enhancements - plantings to aid in flood storage and seeding to aid in species diversity - will improve water quality by optimizing the wetland to trap and store nutrients and other pollutants. During the entirety of the construction phase of the proposed vehicle storage area, erosion control measures will be kept in place to preserve surface water quality and prevent unnecessary sedimentation. The surface water runoff resulting from the proposed development will be collected in the proposed stormwater management system, which will maintain or improve the quality of surface water runoff entering the intermittent stream. The water quality value of the

wetland area that is proposed to be developed will be replaced and improved upon by the stormwater management system.

13) No material will be placed in the intermittent stream which could cause any hazards to safety by impeding flow. No hazards to safety are expected to result from the proposed project.

14) No significant loss of open space will result from the proposed project. The site is an isolated, wooded area in a highly fragmented landscape located within a commercial area of Cranston, RI. It is and is not zoned for open space or used by the public as open space for recreation.

15) The subject wetland is not of high aesthetic quality. It is small in size, isolated from other forested wetlands, and located in a heavily developed area. Therefore, no alteration to a freshwater wetland of usually high visual quality will result from the proposed project.

16) Any decrease in the flood storage capacity of the wetland from the removal of vegetation for the proposed project will be mitigated by the installation of a stormwater management system and the planting of shrub species to assist in flood storage.

17) The rate at which flood water is stored within the subject wetland during a flood event will remain unaffected by the proposed project. The proposed stormwater management system is designed to handle flood events and the proposed project area is outside of the flow channels within the wetland.

18) The subject site is located within FEMA Flood Zone X, which is outside the 500-year flood zone. No restricted or significant modification of the path or velocities of flood flows for the 1-year, 10-year, or 100 year frequency, 24-hour, Type III storm events will result from the proposed project.

19) No structures or obstructions will be placed in the intermittent stream which could cause harm to life, property or other wetland functions and values by impeding flow.

20) The subject wetland receives stormwater runoff from culverts on the northwest and southwest corners of the wetland as well as from surrounding upland areas. The unaffected western and southern areas of the wetland will remain intact, therefore the runoff capacity of the wetland to handle stormwater from the western entry points will not be impaired Any increases in surface water runoff resulting from the impervious surface of the proposed project will be handled by the proposed stormwater management system. No increase in the peak flood elevations for the listed storm events is expected within the subject wetland.

21) As stated above, any increases in surface water runoff resulting from the proposed project will be handled by the proposed stormwater management

system. In addition, this system has been designed to address any increases in runoff volumes and discharge rates to the intermittent stream. No exacerbation of flooding conditions is expected to occur with the implementation of the proposed project.

22) The subject wetland is an isolated forested area within a commercial landscape, however, it is hydraulically connected to forested wetlands downgradient by way of the intermittent stream on the subject property that continues across Sailor Way and onto the adjacent property within a drainage ditch. No significant changes to the quantities and flow rates of surface or groundwater along this flowpath are expected.

23) No structural best management practices will be placed within the wetland and there is no proposal to utilize the subject site as a detention or retention facility,

24) The proposed stormwater management system has been designed to address any increases in runoff volumes and discharge rates to the intermittent stream, thereby mitigating any potential increase to the quantity and flow of surface water entering the stream. The filling of a portion of the wetland is not expected to impact groundwater supply, since the vehicle storage area is elevated above the elevation of the wetland at the existing grade of the paved parking area. The proposed project may reduce some surface water infiltration in the northern portion of the wetland due to the impervious surface of the vehicle storage area, but the project is unlikely to affect the groundwater elevation or water quality of the remaining wetland, which will remain intact.

25) Per conversations with RIDEM, additional federal and state permits, such as a Programmatic General Permit (PGP) with the New England Division of the U.S. Army Corps of Engineers (USACE) and/or compliance permit with the U.S. Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) and Rhode Island Pollutant Discharge Elimination System (RIPDES), are not applicable to the site and will not be included for concurrent submittal with this application.

26) The proposed project is not likely to impact the ability of the remaining wetland area to function at its current level as a natural treatment system for pollutants in surface water runoff entering from the adjacent properties. The additional proposed wetland enhancements - plantings to aid in flood storage and seeding to aid in species diversity - will improve water quality by optimizing the wetland to trap and store nutrients and other pollutants.

4.0 CONCLUSION

The proposed project on the property located at 2050 Plainfield Pike in Cranston, RI includes the addition of a stone vehicle storage area on the southern edge of the current parking lot, over an area that is currently forested. The stone vehicle storage area, designed to accommodate additional parking for the subject property, will measure approximately 3,512 sq ft and will have a liner and a subdrain which will discharge to a sediment forebay and bioretention area.

Due to the lack of feasible alternative locations on the subject property, this project will require alteration to some of the regulated wetland and intermittent stream associated with this property and may have a lesser affect on the remainder of this regulated wetland located on the adjacent property. In order to construct the stone vehicle storage area, a portion of the forested wetland (approx 3,096 sq ft) will be filled. An additional 1,931 sq ft of disturbance will occur within the 100' riverbank buffer in order to construct the sediment forebay and bioretention area.

Appropriate best management practices have been incorporated into the project design. Specifically, the sediment forebay and bioretention basin will aid in stormwater management by improving water quality and aiding in flood control of stormwater runoff from the surrounding impervious surfaces prior to reaching the wetland and intermittent stream channel. The potential loss in flood storage from the elimination of a portion of the forested wetland will be counterbalanced by the addition of the stormwater management system. Mitigation measures will be taken to enhance the remaining wetland areas on the subject property and adjacent property. These measures include plantings to aid in flood storage, manual removal of invasive vegetation, and seeding to restore optimal wetland species. These measures will aid in plant species diversity and maximize potential for wildlife habitat.

Based on the proposed design, this project does not represent a random or unnecessary disturbance to the freshwater wetlands that occur within and adjacent to the subject property.

5.0 REFERENCES

Environmental Laboratory. 1987. "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-l, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Rhode Island Department of Environmental Management. 2010. State of Rhode Island and Providence Plantation Rules and Regulations Governing the Administration and Enforcement of the Fresh Water Wetlands Act.

RI Geographic Information Systems. Extracted from the ArcGIS Shapefiles: Distribution of Bird Species in Rhode Island. 1996. University of Rhode Island. November 2012.

RI Geographic Information Systems. Extracted from the ArcGIS Shapefiles: Natural Heritage Areas. 1993. Department of Environmental Management/The Nature Conservancy Natural Heritage Program. November 2012.

RI Geographic Information Systems. Extracted from the ArcGIS Shapefiles: Soil Survey Geographic Soil Polygons for the State of Rhode Island. 2012. U.S. Department of Agriculture, Natural Resources Conservation Service. November 2012.

RI Geographic Information Systems. Extracted from the ArcGIS Shapefiles: U.S. Fish and Wildlife Service. National Wetland Inventory. 2001. Classification of Wetlands and Deepwater Habitats of the United States. November 2012.

RI Geographic Information Systems. Extracted from the ArcGIS Shapefiles: U.S. Geologic Survey. 1987. 7.5 Minute Topographic Map – Providence Quadrant. November 2012.

U.S. Army Corps of Engineers. 2009. *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region*, ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-09-19. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Attachment A

ERIC D. SIMPSON, L.S.P., P.G.

Office Manager

EDUCATION

B. A., Middlebury College, Geology, 1995

PROFESSIONAL REGISTRATIONS AND CERTIFICATIONS

Licensed Site Professional, Massachusetts, LSP #8881
Professional Geologist, New Hampshire, PG #583

RELEVANT WORK EXPERIENCE

Mr. Simpson has over 17 years of professional experience in the environmental consulting field, which includes management of programs ranging from major petroleum sector clients to the United States Region 1 Environmental Protection Agency, to environmental investigations of the Pilgrim Nuclear Power Plant in Plymouth, Massachusetts to oil refineries, manufactured gas plants, electric-arc steel mills, plastics and chemical processing plants. He has served as Account Manager, Program Manager, and CQC Supervisor for multimillion dollar contracts with the U. S. Army Corps of Engineers, U. S. Environmental Protection Agency, and U. S. Navy as well as major private sector clients in the petroleum industry. He is responsible for environmental assessment and remediation for projects in both Massachusetts and New Hampshire. Mr. Simpson has extensive experience with field operations, report preparation, and staff management. He is the Operations Manager for the Mansfield, Massachusetts office. Mr. Simpson's selected project experience is presented below.

PROJECT EXPERIENCE

Remedial Action Contract at Former Fort Devens, U. S. Army Corps of Engineers—Mr. Simpson serves as Contractor Quality Control Supervisor for an engineering evaluation / cost analysis (EE/CA) and non time-critical removal action (NTCRA) of heavy metal-impacted sediments at the Railroad Roundhouse, a former Boston & Maine locomotive turntable, roundhouse, and repair yard, in the Plow Shop Pond Area of Former Fort Devens, MA. He directs, develops, and implements contract- and project-specific QA/QC procedures and protocols that are compliant with federal, state, and local statures, ensures the implementation of the QAPP, and conducts regular quality audits for all site work and data related to contract task orders.

Retail Service Stations, Petroleum Sector Client—Mr. Simpson is the Account Manager for a petroleum sector client with a portfolio of environmentally impacted sites in NH and MA with combined annual revenues of approximately $8 million. Mr. Simpson currently oversees a staff of three LSPs, eight project managers, sixteen scientists/engineers, and three administrative support staff. His responsibilities include complete client management, project direction, senior report level review, report preparation, project manager mentoring, staff management and training, agency interaction, budgeting, state reimbursement programs (i.e. Massachusetts 21J and New Hampshire Direct Pay), and quality assurance/quality control.

Remedial Action Contract at Former Fort Devens, USACE New England District—Mr. Simpson serves as Contractor Quality Control Supervisor of 8 task orders for remedial action, investigation, remedial design, O&M and optimization at the Former Fort Devens and other sites for the U. S. Army Corps of Engineers, New England District under a $25M contract. He directs, develops, and implements contract- and project-specific QA/QC procedures and protocols that are compliant with federal, state, and local statures, ensures the implementation of the QAPP, and conducts regular quality audits for all site work and data related to contract task orders.

Environmental Multiple Award Contract (EMAC), U. S. Navy—Mr. Simpson is the regional manager for projects at U. S. Naval Station Newport, RI, (NAVSTA Newport) under Sovereign's U. S. Navy EMAC. Mr. Simpson currently oversees several demolition and environmental restoration projects at NAVSTA Newport, supervising a staff of three project managers and five scientists/engineers. Mr. Simpson is responsible for environmental, health and safety oversight at project sites as well as communications with U. S. Navy contracting officers regarding work plans, QA/QC plans, work implementation, and work finalization.

EPA Region I Superfund Technical Assistance Response Team (START III)—Mr. Simpson was Program Manager for the U. S. EPA Region I START 8(a) contract, with a portfolio of CERCLA-listed properties throughout New England including landfills, chlorinated solvent-impacted properties, metals/foundry operations, and former tanneries. He was fully responsible for all communication, project direction, and deliverables with Region I EPA. Mr. Simpson oversaw a contract team of 3 LSPs, one LEP, two PGs, 3 program lead managers, and 14 scientists/engineers. His responsibilities include complete client management, project direction, senior level report review, report preparation, staff management, agency interaction, budgeting, and quality assurance. He investigated several sites in the New England Region including a former MGP gas plant in New Hampshire, dumping/buried drum sites in MA, CT, and NH, and former manufacturing/plating plants in CT.

Bedrock Investigations, Major Oil Company—Mr. Simpson is the LSP/PG and senior project manager for several impacted bedrock aquifer sites in MA and NH. He is the technical resource utilized by a major oil company for the investigation and remediation of impacted bedrock aquifers. Mr. Simpson serves as the technical lead with respect to remote sensing, geophysical investigation (borehole and surface refraction seismic), bedrock mapping, tracer studies, fracture isolation studies, and bedrock aquifer interconnectivity testing. Mr. Simpson has designed several bedrock remediation systems in diverse geological settings such as fractured diorite, bedded phyllitic schist, bedded conglomerates, and intrusive igneous rock settings.

Public Involvement MCP Site—Mr. Simpson is Senior Project Manager and LSP for an ongoing public involvement MCP site in Stoughton, MA originating from a ½ mile MTBE plume in groundwater which impacted 12 private residential wells. He coordinated with the Town Board of Health agent, Conservation Commission and the public regarding the status of cleanup activities. Mr. Simpson designed and oversaw the installation of a 40 gallon per minute groundwater extraction and treatment system which has removed more than 90% of the groundwater impacts at the site.

Public Involvement Petroleum Impacted Site—Mr. Simpson was Senior Professional Geologist for a public involvement petroleum impacted site in NH originating from a ¼ mile MTBE plume in groundwater which impacted 17 private residential wells, a municipal library, Grange Hall, church, and

grocery store. He provided public outreach and staffed several public involvement meetings to discuss the remediation of the site.

Various Phase I Environmental Site Assessments—Mr. Simpson has completed more than 750 Phase I environmental site assessments. He oversaw subsurface investigations at several Superfund sites in New England and MA disposal sites, which involved bedrock drilling, bedrock well installation, hollow stem auger drilling, geoprobe drilling, and soil and groundwater sampling.

Pilgrim Nuclear Power Plant—Mr. Simpson served as the Project Manager for Phase I/II ESA investigations of the Pilgrim Nuclear Power plant in Plymouth, Massachusetts. He investigated and provided environmental support for a network of petroleum underground storage tanks providing emergency and redundant operations support for the nuclear power plant.

Con Edison Astoria Generating Station—Mr. Simpson served as Project Manager for the hydrogeological investigation of the Con Edison Astoria generating station in Queens, NY. He was responsible for the investigation of a series of historical releases and one current release from a bulk #2 and #4 oil tank farm area which were resulting in LNAPL breakout into the East River.

Heavy Industry Mergers and Acquisitions—Mr. Simpson served as Project Manager for an assessment/compliance assessment group based in Providence, RI supporting the mergers and acquisitions markets for heavy industry. Mr. Simpson performed assessments of diverse projects including a nuclear power plant, oil refineries, electric-arc steel mills, plastics and chemical processing plants.

Petroleum and Solvent-Impacted U. S. EPA Superfund site—Mr. Simpson was lead hydrogeological investigator for petroleum and solvent impacts at the USEPA Iron Horse Park Superfund Site in Billerica, Massachusetts. He was responsible for the management of groundwater sampling of an existing well network and for subsurface soil investigations of two former petroleum discharge lagoons at the abandoned locomotive repair yard.

Manufactured Gas Plant (MGP) Site, Massachusetts —Mr. Simpson served as hydrogeological investigator for two former MGP plants in Massachusetts on behalf of a natural gas distribution company.

Diesel Fuel Impacted Freight Yards—Mr. Simpson acted as lead hydrogeological investigator for diesel fuel impacts for Conrail's Framingham, MA and Allston, MA rail freight yards. He designed and implemented subsurface drilling, sampling, and assessment investigations to delineate diesel fuel plumes.

U. S. EPA Superfund Site—Mr. Simpson was a hydrogeological investigator on the U. S .EPA Wells G&H Superfund site in Woburn, MA. He was responsible for the quarterly monitoring of groundwater and monitoring of electronic data collection devices located across the Superfund Site. He prepared reports and summarized data collection efforts.

PROFESSIONAL TRAINING AND CONTINUING EDUCATION

40-Hour OSHA HAZWOPER Training
8-Hour OSHA HAZWOPER Annual Refresher
8-Hour OSHA Site Supervisor
USACE Construction Quality Management for Contractors, January 2011
Defensive Driver Training

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

Licensed Site Professional Association

LAURA SIMKINS

Project Manager

EDUCATION

B.S., University of New Hampshire, Wildlife Management, 2002
M.S., University College Dublin, Applied Environmental Science, 2006

RELEVANT WORK EXPERIENCE

Ms. Simkins has over 7 years of professional experience in the environmental field. Her professional experience includes coordination of site assessment and remediation projects, monitoring field activities, report preparation for both state and Federal agencies, client briefings, and management of project budgets up to $2M. She possesses expertise in delineation of wetland boundaries, in accordance with the U. S. Army Corps of Engineers 1987 Wetland Delineation model as modified by the USACE Regional Supplements, and she has prepared wetland reports for agency review based on delineation data collected in the field. Selected project experience is presented below.

PROJECT EXPERIENCE

USEPA Region 1 Superfund Technical Assessment and Response Team - Managed a team of workers conducting site assessments for 15+ sites in EPA Region 1 (including CT, RI, MA, NH, VT, and ME) under the EPA Superfund Technical Assistance and Response Team (START) program through which state-nominated hazardous waste sites are investigated by EPA for a determination of placement on the Superfund National Priorities List. Site investigation includes a comprehensive evaluation of surface water, groundwater, soil, and air impacts that may pose a risk to the surrounding environment and human health. Sample media collected included surface water, sediment, groundwater, and surficial and subsurface soil. Examples of sites managed and investigated include: metal plating facilities, a coal gasification plant, welding facilities, landfills, an historic shoe-manufacturing facility, and an agricultural property with over 1,700 buried drums.

US Army Corps of Engineers, Former Fort Devens - Managed a team of workers conducting a removal action at the Former Markley Range as part of site remediation and redevelopment activities on a former firing range. Work was performed as part of base closure activities under a five-year, $25M remedial action contract at the Former Fort Devens in Devens, Massachusetts. Management involved contractor coordination, well installation, groundwater and sediment sampling, Multi-Increment Sampling of soils for ecological risk assessment, and wetlands delineation.

Retail Service Stations, Major Oil Company - Conducted environmental assessments and remediation under the guidelines of the Massachusetts Contingency Plan (MCP) for Shell Oil Products US retail service stations and terminals in Massachusetts and New Hampshire. Conducted subsurface investigations at sites including groundwater and potable well sampling, soil gas screening, surveying, slug testing, and installation and operation of ISOC well systems. Oversaw subsurface work including

hollow stem auger drilling, geoprobe drilling, ground penetrating radar (GPR) scanning, and excavations. Managed project budgets and report data, briefed clients on site planning, and produced comprehensive technical reports documenting subsurface contamination and hydrogeologic conditions.

Point Reyes Bird Observatory (PRBO) Conservation Science - Performed visual surveys for shorebirds on the beaches of the Point Reyes National Seashore. Duties included monitoring birds' movements, behavior, and nest success. Other primary responsibilities included building nest exclosures, data entry, and cooperating and managing volunteers on a daily basis.

U.S. Geological Survey - Performed auditory and visual surveys for passerine migrants and non-migrants within a management area. Duties included capturing birds using mistnets, banding all birds captured, radio-tagging one select species (wood thrush), and extensive tracking of all tagged birds using radiotelemetry. Other work included nest searching, transect mapping, vegetation plot surveying, and data entry.

National Park Service - Performed surveys for endangered raptors for both demographic and compliance research within the park. For demographic surveys, documented the health and numbers of species. For compliance surveys, documented the presence of species in potential park disturbance locations. Additional responsibilities included topographic navigation in difficult terrain, GIS tracking, and data entry.

U.S. Forest Service - Performed research and collected data on the following subjects: surveying vegetation for suitable lynx den and travel habitat, locating bat habitat in old mining addits, measuring and comparing plant re-growth in harvested plots, and surveying amphibians in high and low elevation wetland areas. Assisted volunteers with thrush surveys, which compared the locations of different thrush species in recreational and forested landscapes.

PROFESSIONAL TRAINING

40-hour OSHA Health & Safety Certification
36-hour Basic Wetland Delineator Training under the US Army Corps of Engineers Wetland Delineation Manual, July 2007
EPA Sampling for Hazardous Materials Training, April 2008
EPA Hazard Ranking System Training, June 2008
EPA Preliminary Assessment/Site Inspection Training, June 2008
US Army Corps of Engineers Construction Quality Management For Contractors, September 2011
American Red Cross CPR Certification
American Red Cross First Aid Certification
Radiation Meter Trained
Respirator Trained and Fitted

ELLYN C. BRIXIUS

Project Scientist

EDUCATION

B. S., Biology, Kutztown University, 2003

RELEVANT WORK EXPERIENCE

Ms. Brixius has more than 8 years of experience in the environmental consulting field. She possesses skills with wetland mitigation, restoration and monitoring activities, wetland delineation, baseline ecological assessments, and threatened and endangered species reviews and surveys. Ms. Brixius has expertise in regulatory permitting, including applications for defining wetland boundaries in multiple states, freshwater wetlands general permits, flood hazard permits, and waterfront development permits. In accordance with the U. S. Army Corps of Engineers 1987 Wetland Delineation model and as modified by the USACE Regional Supplements, she has prepared numerous wetland reports for agency review based on delineation data collected in the field. Her federal permitting activities involved regulations under the Clean Water Act, particularly Section 404, with the U. S. Army Corps of Engineers, Section 401 with various state agencies, and Section 402 with delegated counties. Ms. Brixius is familiar with project management, wastewater treatment permitting with NJPDES, modeling site remediation and wetlands work with GPS, Phase I and II environmental site assessments, Baseline Ecological Evaluations, and Ecological Risk Assessments at sites in DE, NJ, PA, MA, MD, and VA. Ms. Brixius joined Sovereign in April 2007.

PROJECT EXPERIENCE

Wetlands and Riparian Corridor Delineation, United States Army Corps of Engineers – New England District – Ms. Brixius performed a freshwater wetland and riparian corridor delineation and prepared a *Wetland Delineation Report* on behalf of the U.S. Army Corps of Engineers, New England District (USACE), for properties in the vicinity of Shepley's Hill Landfill (**SHLF**) in Ayer, Massachusetts. The purposes of the activities were to ascertain whether jurisdictional freshwater wetlands exist within areas of proposed disturbance associated the installation of monitoring wells (including site access) and the clearing of geophysical survey lines, and if so, to delineate the wetland extent and the Nonacoicus Brook riverfront area to define the inner and outer riparian corridor. Wetland delineation procedures followed the "routine method" outlined in the Corps 1987 Wetlands Delineation Manual, as modified by U.S. Army Corps of Engineers Interim *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (2009).* Further, the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) were observed and the policies and procedures within those regulatory guidelines were implemented by utilizing the methodologies in the Massachusetts document *Delineating Bordering Vegetated Wetlands.* The proposed site investigation activities were time sensitive and their completion contingent upon approval of the delineated wetland line and riparian corridor by the authority of the local township, which was granted shortly after the conclusion of the delineation and reporting activities.

Wetlands Regulatory Monitoring and Restoration, Naval Facilities Engineering Command, Washington—Ms. Brixius has completed her third year of wetland monitoring, invasive species monitoring and control, and supplemental restoration activities for several mitigated and restored wetlands at a Naval Supply Facility in Dahlgren, VA under contract to NAVFAC Washington. Ms. Brixius's role in the program was initially to partner with a second environmental consultant to perform the fieldwork and submit annual reports documenting the progress of restored and mitigated wetlands in accordance with requirements set forth by the EPA Region III Biological Technical Assistance Group (BTAG), which is comprised of members from the Virginia Department of Environmental Quality, U.S. Fish and Wildlife and the Environmental Protection Agency. Ms. Brixius is also responsible for presenting the wetland monitoring results and proposals to members of BTAG and the client on an annual basis. However, her role advanced into working directly with the client, the Naval Facility Environmental Group and BTAG to develop new sampling plans and restoration proposals to meet compliance objectives for closure of each individual wetland location. Ms. Brixius has assisted in developing and implementing four successful restoration activities including shoreline stabilization and vegetated tidal mudflat establishment, development of a forested/scrub shrub wetland and the expansion of emergent wetland area from existing open water habitat.

Emergency Wetland Permit Compliance, Major Utility Company—Ms Brixius performed wetland and transition area delineation of an existing electrical Right-of-Way (ROW) in St. Michaels, Maryland. Pursuant to the emergency permit requirements, approximate pre-existing non-tidal wetland, buffers and streams at the site were assessed via observing the National Wetland Inventory mapped wetlands and the Maryland Department of Natural Resources mapped wetlands. Subsequent to the completion of the emergency activities, the existing wetland and transition area were delineated utilizing the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (2009).* Trimble GEO XT GPS data was collected to document the wetland/transition area boundaries and produce GIS compatible figures for submission to the regulatory agency. A summary of best management practices used during the emergency work activities, methods of delineation, classification of non-tidal wetland encountered within the ROW and the landscape and soil of the area were submitted to the Maryland Department of the Environment to document compliance with the requirements of the emergency wetland permits.

Wetland Permit Compliance, Major Utility Company—Ms. Brixius performed wetland and transition area delineations of existing electrical Right-of-Ways (ROW) in several locations in the state of Maryland including the towns of Berlin, Trappe, Easton, Georgetown, Oak Hall, Salisbury and Tanyard. Pursuant to the specific regulatory requirements for each county within Maryland approximate pre-existing tidal or non-tidal wetland, buffers and streams at each site were assessed via observing the National Wetland Inventory mapped wetlands and the Maryland Department of Natural Resources mapped wetlands in addition to the Natural Resources Conservation Service soil surveys. Subsequent to the in-house review of potential site conditions and county specific regulatory requirements, the existing wetland and transition areas were delineated utilizing the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (2009).* Trimble GEO XT GPS data was collected to document the wetland/transition area boundaries and produce GIS compatible figures for submission to the regulatory agency. A summary of methods of delineation, types of tidal and non-tidal wetlands encountered within the ROW and the landscape and soil of the area were submitted to the Maryland Department of the Environment to document compliance.

Wetland Permit Compliance, Major Utility Company—In anticipation of upcoming improvements within an 18 mile section of existing electrical Right-of-Way (ROW) which spans two states (Delaware and Maryland) and several counties, Ms. Brixius was responsible for determining and mapping the best access route for vehicular traffic for the entire line to avoid impact to wetlands and other sensitive areas. Where wetlands and other sensitive areas were unavoidable, Ms. Brixius delineated the existing wetland and transition area boundaries utilizing the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (2009)*. Trimble GEO XT GPS data was collected to document the wetland/transition area boundaries and produce GIS compatible figures for submission to the regulatory agency. A summary of methods of delineation, classification of wetlands encountered within the ROW and the landscape and soil of the area were utilized by the client to develop a work plan and document compliance to the Maryland Department of the Environment and the Division of Water Resources of the Delaware Department of Natural Resources and Environmental Control.

Wetlands Regulatory Permitting and Fieldwork, Chemical Company—For a client chemical plant in Clayton, NJ, Ms. Brixius performed an on-site wetland delineation to determine the area of potential impact upcoming remedial activities may have on the wetland and/or wetland transition areas. She is currently preparing an NJDEP application package for a Freshwater Wetlands LOI and General Permit 4 for the property. Additionally, Ms. Brixius will propose the wetland mitigation plan associated with the permitting application/remedial work and oversee the wetland restoration activities and monitoring.

Wetlands Regulatory Permitting and Fieldwork, Major Oil Company—Ms. Brixius performed a wetland delineation to determine the area of potential impact upcoming remedial investigation activities may have on the wetland and/or wetland transition areas at a Pilot Travel Center retail petroleum facility in Carneys Point, NJ. Subsequently, Ms. Brixius prepared the NJDEP application package for a Freshwater Wetlands LOI and General Permit 14 for the regulated activities.

Transcontinental Gas Pipe Line Corporation (Transco), Marketlink Expansion Project, Pennsylvania Sites—Ms. Brixius inspected and monitored restored wetlands along more than 60 miles of Right-of-Way (ROW) of replaced and upgraded pipeline between Haneyville, Williamsport, Benton, and Allentown, PA. Ms. Brixius assisted with the post-construction wetland monitoring and report submittal throughout the entire 3-year project. The yearly inspection and monitoring was a condition of the Individual Wetlands Permits issued by the Pennsylvania Department of Environmental Protection (PADEP) that were submitted by Transco for a pipeline upgrade. Using the Relevé Method plant sampling technique, Ms. Brixius was able to obtain both qualitative and quantitative data to achieve permit condition compliance. Ms. Brixius used the data collected with this approach to provide a formal and comprehensive characterization of each wetland community within the required annual report. Additionally, the final year of monitoring required the delineation and survey for each restored wetland. Using GPS data collected by Ms. Brixius and other scientists, the final report was able to accurately present that the post-construction delineated wetlands corresponded with the pre-construction delineated wetland lines.

Transcontinental Gas Pipe Line Corporation (Transco), Marketlink Expansion Project, New Jersey Sites—Ms. Brixius inspected and monitored post-construction ROW wetlands in Mt. Laurel, Trenton, and Bordentown, New Jersey. As a condition of the Individual Freshwater Wetland Permits issued by the New Jersey Department of Environmental Protection, Ms. Brixius inspected and monitored restored

wetlands during the 3-year pipeline upgrade and replacement period. She used her knowledge of the Relevé Method plant sampling technique to represent the evolving conditions within each restored wetland accurately. Ms. Brixius gathered GPS data to compare pre- and post-construction wetland delineation along the ROW.

Transcontinental Gas Pipe Line Corporation (Transco), Marketlink Expansion Project, New Jersey Sites—As a condition of an NJDEP Freshwater Wetlands General Permit for the temporary disturbances of wetlands along the Fairless Loop near Bordentown, NJ, Ms. Brixius monitored post-construction wetlands in accordance with the Federal Energy Regulatory Commission (FERC) Wetland and Waterbody Construction and Mitigation Procedures. The main focus of the monitoring was to determine if at least 80 percent cover of the total area disturbed was re-established with native herbaceous and/or woody species, and that the diversity of native species was at least 50 percent of the diversity originally found in the wetland. Ms. Brixius performed the required wetland inspections, monitoring, and annual report preparation.

Transcontinental Gas Pipe Line Corporation (Transco), Marketlink Expansion Project, Maryland and Pennsylvania Sites—Ms. Brixius performed wetland delineations in accordance with the Federal Manual for Identifying and Delineation Jurisdictional Wetlands, 1989, over approximately 50 miles of pipeline ROW near Baltimore, MD, and northern areas, extending into PA. In anticipation of operation and maintenance activities regulated under FERC 2.55(B) deteriorated pipelines, the goal of the project was to delineate all wetlands along the ROW and record spatial locations utilizing GPS technology. The delineated wetlands and the GPS data Ms. Brixius gathered were used to prepare accurate wetland footprints onto existing ROW alignment drawings.

Columbia Gas Transmission Corporation, Line 1278 BPN Project—Located in Bucks, Lehigh, and Northampton Counties in Pennsylvania, Line 1278 was constructed in the 1950s using non-coated, bare steel pipe. Based on investigations through their Integrity Management Program (IMP), Columbia adopted a replacement program to replace the deteriorated pipe. Ms. Brixius assisted in the wetlands delineations along the ROW that were the basis for the required regulatory permitting associated with the Blanket Prior Notice (BPN).

Retail Service Stations, Major Oil Company—Ms. Brixius currently manages 27 retail petroleum remediation sites in northern and southern New Jersey for Shell Oil Products, US. She manages the design and implementation of remedial action and remedial action plans, and maintains regular communication with client contacts and regulatory bodies. She writes project reports as well as remediation work plans and procedures, while addressing NJDEP regulations. Ms. Brixius performs soil and groundwater sampling, and GPS modeling as needed.

Wetlands Regulatory Permitting and Fieldwork, Chemical Company—For a client chemical plant in Edison, NJ, Ms. Brixius processed a variety of wetlands regulatory permitting activities. She prepared an NJDEP application package for a Freshwater Wetlands LOI, a Waterfront Development Permit, and Freshwater Wetlands General Permits #2 and #14.

Delaware River Fly Ash Recovery Permitting Project—Following an accidental release of several million gallons of fly ash into the Delaware River at Martin's Creek, PA, Ms. Brixius worked closely

with the client, PPL, to prepare and submit the required regulatory permits to complete the cleanup activity. Ms. Brixius assisted with the in-field assessment of surrounding wetlands and the potential impact temporary water treatment stations would have on them. Several plans for the locations of the treatment systems were explored and Ms. Brixius was involved in determining what federal and local permits would need to be obtained in each state (New Jersey and Pennsylvania) for each potential scenario. Once a plan was established, Ms. Brixius helped prepare and submit permit application packages which included U. S. Army Corps of Engineers Nationwide Permits, State Stream Encroachment Permits, State Freshwater Wetland General Permits, Water Quality Checklists, National Pollution Discharge Elimination System permits, and the County Erosion and Sediment Control permitting requirements for each treatment location. Ms. Brixius also served as an intermediary between all of Shaw's temporary offices, which were conducting the remediation, and PPL for the project.

Bayway Refinery, Linden, NJ—Located along the Arthur Kill River, the Bayway Refinery is considered a "high priority" facility by the Department of Homeland Security and the Environmental Protection Agency. Over three years, Ms. Brixius prepared and submitted several U. S. Army Corps of Engineers Nationwide Permits, NJDEP Freshwater Wetland General Permits, Waterfront Development Permits, and individual permits to assist the refinery in compliance with the NJDEP ad construction, dredging, and other maintenance needs dictate.

Picatinny Arsenal, Morris County, NJ—Ms. Brixius assisted with the wetland delineation activities at the Oil Water Separator and the Bear Swamp Brook Sediment Location 34, and, along with other Shaw employees, prepared the applicable permits required for the remediation projects at these sites. This task was performed on behalf of the Army Corps of Engineers, Baltimore District, and the Picatinny Arsenal Environmental Affairs Office to determine and define the extent of state regulated wetlands within these sites. Ms. Brixius also assisted in seeding and planting several native saplings and herbaceous plant species at various places within the site.

Maywood FUSRAP Site, Maywood, New Jersey—Ms. Brixius assisted with the preparation and submittal of the required NJDEP Stream Encroachment and Freshwater General Permits required for the remediation efforts taking place at the Formerly Utilized Sites Remediation Action Program (FUSRAP) in Maywood, NJ.

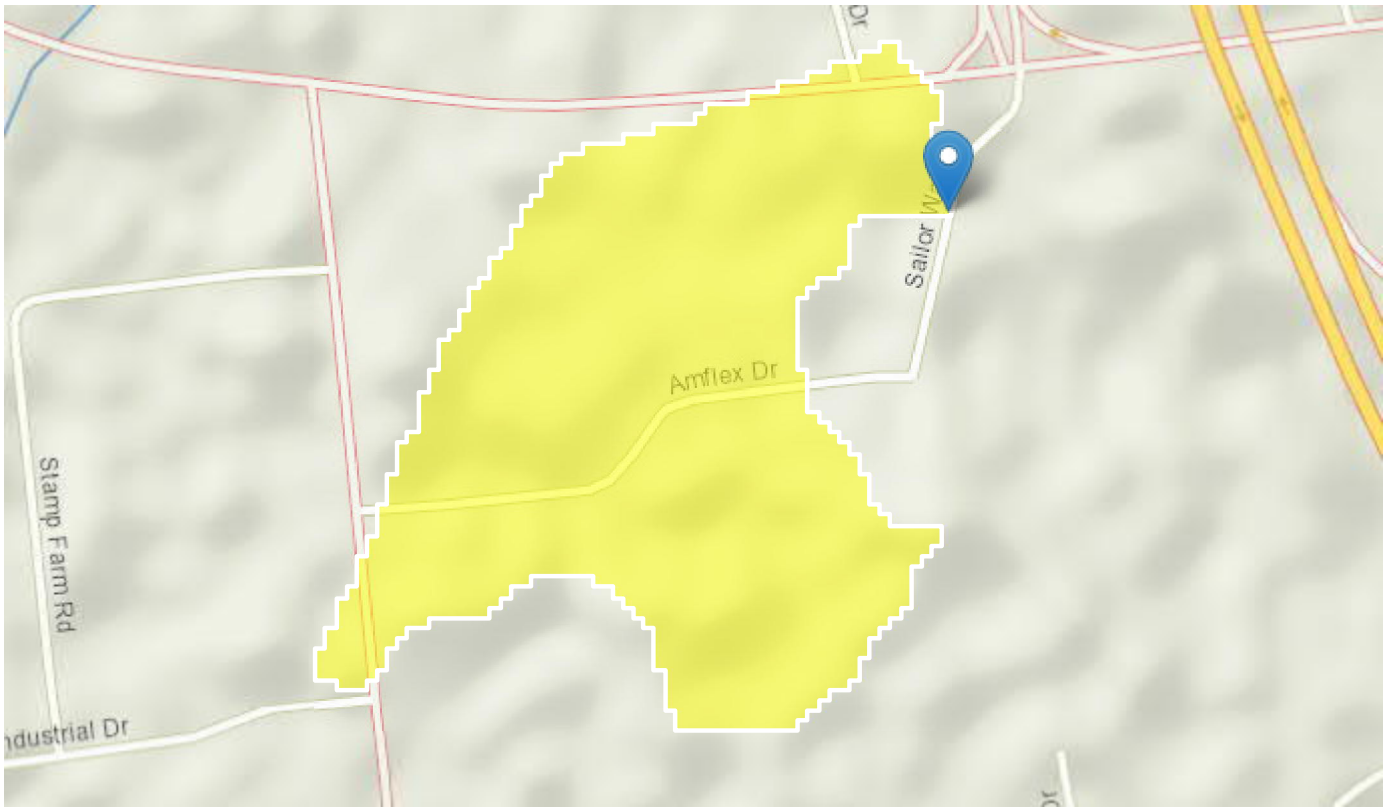
PROFESSIONAL TRAINING AND CONTINUING EDUCATION

40-Hour OSHA HAZWOPER
8-Hour OSHA Annual Refresher
8-Hour Air Shipment of Hazardous Goods DOT 40 CFR 172.704
Vegetation Identification for Wetland Delineation, Rutgers University—Cook College, June 2003
38 Hour Army Corps of Engineers Wetland Delineation Training Program,
USACE Regional Supplement Training, 2009

A3.5.4.9 Streamstats Report

StreamStats Report

Region ID: RI
Workspace ID: RI20220617141328163000
Clicked Point (Latitude, Longitude): 41.78756, -71.50943
Time: 2022-06-17 10:13:48 -0400



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CAT1ROADS	Length of interstates lmtd access highways and ramps for lmtd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	0	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmtd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	0	miles

Parameter Code	Parameter Description	Value	Unit
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	0.14	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	0.35	miles
CROPS	Percent of area covered by agriculture	11.1	percent
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	0	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	0	dimensionless
CROSCOUNT3	Number of intersections between streams and roads, where roads are local conecting roads (CAT3ROADS)	0	dimensionless
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	0	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	17.4	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	80.5	feet per mi
DRNAREA	Area that drains to a point on a stream	0.0738	square miles
ELEV	Mean Basin Elevation	343	feet
FOREST	Percentage of area covered by forest	7.35	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	85.4	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	55.9	percent
LFPLENGTH	Length of longest flow path	0.64	miles

47.232ac

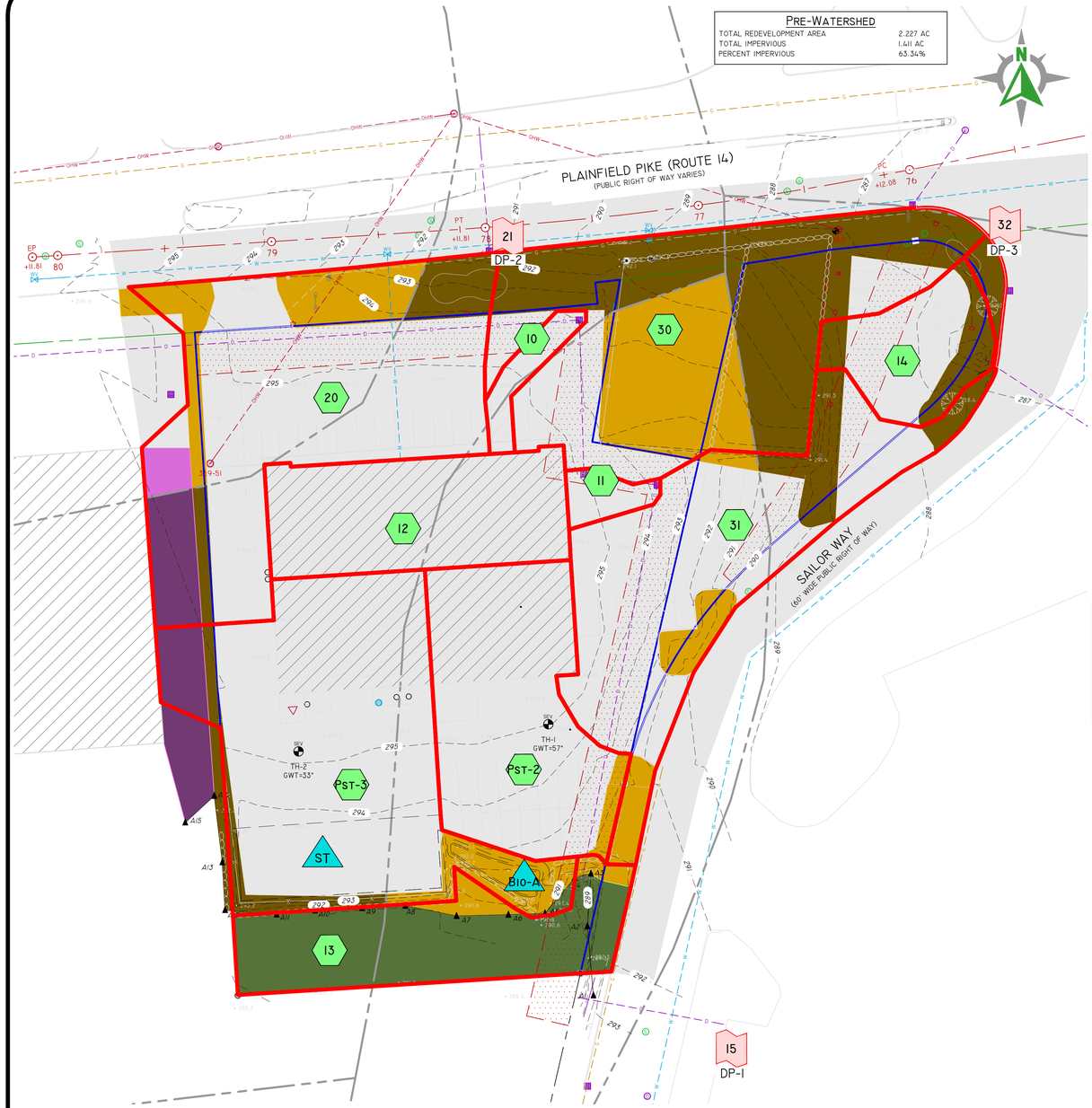
Parameter Code	Parameter Description	Value	Unit
STORNHD	Percent storage (wetlands and waterbodies) determined from 1:24K NHD	0	percent
STRDEN	Stream Density -- total length of streams divided by drainage area	0	miles per square mile
STRDENED	Stream Density -- total length of streams divided by drainage area, edited from NHD	0	miles per square mile
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	0	miles
STRMTOTED	Total stream length in miles - edited NHD	0	miles
WATER	Percent of area covered by open water (lakes, ponds, reservoirs)	0	percent
WETLAND	Percentage of Wetlands	5.6	percent

Application Version: 4.9.0
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

Watershed Maps

PRE-WATERSHED

TOTAL REDEVELOPMENT AREA	2.227 AC
TOTAL IMPERVIOUS	1.411 AC
PERCENT IMPERVIOUS	63.34%



PRE-WATERSHED
REDEVELOPMENT AREA

SCALE: 1"=30'
0 15' 30' 60'

POST-WATERSHED

TOTAL REDEVELOPMENT AREA	2.227 AC
TOTAL IMPERVIOUS	1.082 AC
PERCENT IMPERVIOUS	48.58%

POST-WATERSHED
REDEVELOPMENT AREA

SCALE: 1"=30'
0 15' 30' 60'

LEGEND

- WOODS - B SOILS
- WOODS - D SOILS
- GRASS - B SOILS
- GRASS - D SOILS
- GRAVEL - B SOILS
- GRAVEL - D SOILS
- IMPERVIOUS

LEGEND

- TC LINE WITH ELEVATIONS (37.5 A 37.5 B)
- SUBCATCHMENT AREA
- SOIL BOUNDARY
- REACH

- SUBCATCHMENT — 100
- DRAINAGE POND/BIO RETENTION/SAND FILTER/INFILTRATING SWALE — 100
- DRAINAGE STRUCTURE/POND WITH INSIGNIFICANT STORAGE — 100
- REACH/SWALE — 100
- DESIGN POINT — 100

WATER QUALITY CALCULATIONS

IMPERVIOUS DATA:

TOTAL EXISTING IMPERVIOUS	1.411 AC
EXISTING IMPERVIOUS PST-3	0.251 AC
TOTAL EXISTING IMPERVIOUS FOR 2022 REDEVELOPMENT	1.411 - 0.251 = 1.160 AC
TOTAL PROPOSED IMPERVIOUS	1.082 AC

IMPERVIOUS REDUCTION:

EXISTING IMPERVIOUS FOR 2022 REDEVELOPMENT - PROPOSED	1.411 - 1.082 = 0.329 AC

WQ REQUIRED (REDEVELOPMENT):

50% EXISTING IMPERVIOUS FOR 2022 REDEVELOPMENT	1.160 * 50% = 0.580 AC
100% OF PREVIOUSLY REDEVELOPED	0.251 AC

TOTAL WQ REQUIRED:

2022 REDEVELOPMENT	0.580 AC
+ 100% OF PREVIOUS REDEVELOPMENT	+0.251 AC
- IMPERVIOUS REDUCTION	-0.329 AC
	0.502 AC

IMPERVIOUS CALCULATION MAP
SEASONS CORNER MARKET

DiPrete Engineering
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